

# Australasian Plant Conservation

Bulletin of the Australian Network for Plant Conservation Inc



Volume 30 Number 4 March – May 2022



Celebrating the 30th  
anniversary of APC [Part 2]

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### ANPC National Office

GPO Box 1777  
Canberra, ACT 2601, Australia

**T** (02) 6250 9509  
**E** [anpc@anpc.asn.au](mailto:anpc@anpc.asn.au)  
**W** [www.anpc.asn.au](http://www.anpc.asn.au)

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PO Box 2199, Wellington, New Zealand  
**E** [info@nzpcn.org.nz](mailto:info@nzpcn.org.nz)  
**W** [www.nzpcn.org.nz](http://www.nzpcn.org.nz)

**Front cover:** Cath Offord taking a  
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#### Editor

Heidi Zimmer

#### Associate Editors

Nathan Emery and Selga Harrington

#### Editorial Team

Cath Offord, Melissa Millar, Andrew Crawford,  
Chris Fernance, Jo Lynch, Tony Auld,  
Damian Wrigley and Andrew Fairney

#### Layout & Graphic Design

Siobhan Duffy

*Australasian Plant Conservation* is produced  
by the ANPC Inc. with assistance from the  
Australian National Botanic Gardens.

*Australasian Plant Conservation* is printed  
on recycled paper.

ISSN 1039-6500

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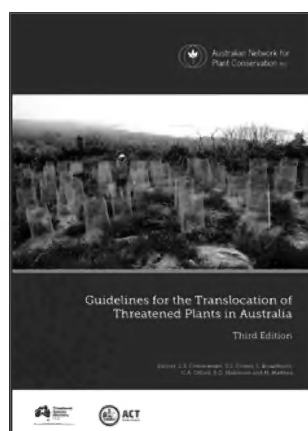
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## Guidelines for the Translocation of Threatened Plants in Australia

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# From the editor

HEIDI ZIMMER

Welcome to APC's celebration of the 30<sup>th</sup> anniversary of ANPC – part 2. We begin with an article from Tony Auld (ANPC president) and David Keith, who take a look at key issues for plant conservation in Australia, in particular our national reserve estate, threatened species and ecological communities, land clearing, offsets and restoration. Next, we have some additional 'Retrospectives and perspectives' contributions – back by popular demand after their popularity in the last issue. Then, Bryn Funnekotter and Eric Bunn introduce us to cryopreservation, an increasingly important technology in plant conservation which, as they explain, enables storage of a wide range of germplasm, and is especially useful for species which cannot be stored using traditional seed banking methods. This is followed by Kathryn Scobie's article on recent plant conservation projects at the Australian National Botanic Garden, including threatened species recovery in Namadgi and Mt Imlay National Parks.

We then move to an article by Lucy Commander and others in which they give a rationale for an Australian Ecosystem Restoration Strategy, and the themes that such a strategy must address. They discuss prioritisation, data management, funding, and facilitation of connections and complementary works, and more.

Next, we have an article from Peter Ardill on restoration activities around Melbourne in the 1890s and early 1900s, including the use of fire in coastal vegetation. This is followed by an article from Di Brown and Peter Richards describing the monitoring and post-fire recovery of *Zieria lasiocaulis* – including significant post-fire germination.

Onto our regular features: news from the ASBP is brought to us by Bradley Desmond, who outlines the great post-fire plant conservation work happening at ASBP, focused on seed collection, rapid flora surveys and germination trials. Collaborative projects include reintroduction of *Andersonia echinocephala* and *Banksia solandri* in the Stirling Ranges (WA) and translocation plantings of *Swainsona pyrophila*, *Brachyscome muelleri* and *Coronidium gunnianum* in the Secret Rocks Nature Reserve and Lobethal Bushland (SA). Our workshop report is from Amelia Martyn enson and others, summarising some of the great work presented at the Australian Academy of Science Fenner Conference on the Environment 'Exceptional Times, Exceptional Plants', focusing on species which cannot be conserved using conventional seed banking. We complete the issue with a member profile, book reviews and research round up. Enjoy!

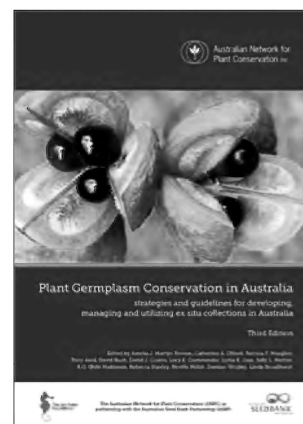
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# Plant conservation in Australia

TONY D. AULD<sup>1,2,3\*</sup> AND DAVID A. KEITH<sup>2</sup>

<sup>1</sup> Australian Network for Plant Conservation

<sup>2</sup> Centre for Ecosystem Science, University of New South Wales

<sup>3</sup> School of Earth, Atmospheric and Life Sciences, University of Wollongong

\*Corresponding author: Tony.Auld@environment.nsw.gov.au

Plant conservation is intimately entwined with the conservation of species, ecological communities, ecosystems and landscapes. It underpins habitat conservation for vertebrates and complements conservation of less well known groups, such as invertebrates and fungi. Here we focus on vascular plants and plant assemblages in ecological communities, acknowledging that our understanding of conservation of non-vascular plants and algae is limited.

Plant conservation in Australia has a number of essential enablers that must all be in place so that conservation can be achieved across landscape to local scales, at the same time as involving government, landholders, traditional custodians of the land and all members of the community. These enablers are: conservation via the national reserve estate; protection of components of biodiversity that are threatened or have high biodiversity value; mitigation of threats; policy, legislative and regulatory actions for ecologically sustainable development; and restoration of degraded habitats. So how well are we tracking in terms of plant conservation in Australia? What have we done well and where must we do better?

## National reserve estate

A proportion of Australia is managed primarily for conservation of plants and animals and the ecosystems they make up, along with significant landforms. This is mostly run through national parks and other reserves, managed by the various governments, although private reserves and indigenous management areas are emerging as important contributions to the protected area estate. Adoption of a comprehensive, adequate and representative reserve network (CARS, NRMCC 2009, <https://www.awe.gov.au/sites/default/files/documents/nrsstrat.pdf>) has guided reservation. As of June 2020, just under 20% of land has some form of reservation, with 8% in the most secure tenure (CAPAD 2020, <https://www.awe.gov.au/agriculture-land/land/nrs/science/capad/2020>). However, representation of bioregions under reservation varies greatly and recent increases continue to be in those areas with the least threats (Keith and Auld 2017). In 2021, new targets of 30% of both land and sea areas, set under a global biodiversity framework on managing nature, attempt to protect and effectively manage areas of particular importance for

biodiversity (CBD 2021, <https://www.cbd.int/conferences/post2020/post2020-prep-01/documents>). So, while we are moving in the right direction for terrestrial conservation, more efforts for under-represented vegetation types and ecosystems, along with refugia and Key Biodiversity Areas (see below) are needed. Adapting the reserve network to climate change is a challenge, given the risk that some species will not tolerate changing environmental conditions, potentially leading to collapse or simplification of some ecosystems. At a minimum, tenure security will see national and state reserves as places for on-going biodiversity conservation, while factoring in species and ecosystem responses to climate change may help inform where future reserves are needed.

## Threatened species and ecological communities and Key Biodiversity Areas

Australia has a highly diverse flora with over 90% of species endemic to the country. Sadly, Australia has a high extinction rate for plants (and mammals). Over 1,350 plants are currently known to be threatened with extinction nationally, while many more are yet to be assessed (Alfonzetti *et al.* 2020), so the list will grow as we work towards a comprehensive and up to date set of threatened plant listings. However, while the IUCN Green List initiative (Akçakaya *et al.* 2018) provides direction for assessing success of conservation measures, very few plants have an effective recovery program that is implemented across the whole distribution of the species. There have been significant recent programs of funding for threatened species conservation (NSW Saving our Species program 2015-ongoing (<https://www.environment.nsw.gov.au/topics/animals-and-plants/threatened-species/saving-our-species-program>) and the new Commonwealth Threatened Species Strategy for 100 priority species (of which 30 are plants) ([https://www.awe.gov.au/sites/default/files/documents/100-priority-species\\_0.pdf](https://www.awe.gov.au/sites/default/files/documents/100-priority-species_0.pdf)). However, resourcing levels remain inadequate to both halt the declines of many threatened species and to stop other species becoming threatened.

Plant conservation initiatives are also captured under listing of threatened ecological communities (TECs) at both national and state/territory levels as most listings are based on vascular plant assemblages.

These TEC listings are currently far from comprehensive and urgently need additional efforts for both identification of ecological communities at risk across Australia, along with implementation of threat mitigation and recovery measures.

Whilst *in situ* conservation remains hampered by a lack of resourcing combined with ongoing threats (see below), *ex situ* conservation has made remarkable progress. Yes, more resourcing is needed, but development and updating of best-practice guidelines to inform germplasm conservation (Martyn *et al.* 2021), translocation (Commander *et al.* 2018) and restoration (Commander *et al.* 2021) now provides a strong foundation for progress.

Of course, conservation of plants is not just about threatened species, and internationally this has been recognised with a new focus on areas that represent highly significant habitats for the conservation of biodiversity (IUCN Key Biodiversity Areas (KBAs), IUCN 2016). KBAs are intended to focus on areas that are a priority for biodiversity conservation and so cover more than just the national reserve network or locations of threatened species or threatened ecological communities. To date, there has been some progress in Australia towards identification of KBAs through Birdlife Australia's efforts to highlight areas that are important for bird conservation (<https://www.birdlife.org.au/projects/KBA>), and the recent NSW adoption of the concept into legislation as Areas of Outstanding Biodiversity Value (<https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/areas-of-outstanding-biodiversity-value>). KBAs are an exciting new initiative and would benefit from the perspectives of plant and vegetation community diversity patterns, along with factors needed to ensure ongoing plant conservation and the maintenance of ecosystem dynamics in Australia. This should help guide the identification of KBAs most relevant for ongoing plant conservation.

## Mitigating threats

Major threats to plant conservation have been well known for decades (Auld and Keith 2009) and most persist (Keith and Auld 2017). Climate change has begun to exacerbate a number of existing threats (e.g., increasing the risk of detrimental effects to biodiversity from too frequent and high severity fires) along with creating novel threats (e.g., accelerated tree mortality, De Kauwe *et al.* 2020) and opportunities for new invasive species (e.g., new pathogens such as Myrtle Rust, Makinson 2018). There has been no successful ongoing and effective threat mitigation framework in Australia, and while listing of Key Threatening Processes under legislation is a way to identify what the issues are and what needs to be done, failure to resource threat mitigation has meant many threats to plants persist or are only dealt with at small, local scales. This contrasts with recent efforts and resourcing to mitigate effects



*Banksia paludosa* ssp. *astrolux*, a highly restricted species severely affected by 2019-2020 fires. Photo: Tony Auld

of fox and cat predation on animals, both in terms of landscape-scale control measures and threat-free or threat-reduced 'sanctuaries'. Incorporating plant conservation needs into such endeavours remains necessary. In addition, we still lack a comprehensive set of best practice guidelines for the management of different major threats to plants.

Most worrying, Keith and Auld (2017) note that clearing (the most severe threat) is ongoing in most vegetation types. They identified increased urbanisation and habitat loss for mining and agriculture as major drivers of ongoing clearing. Reported rates of net change in native vegetation cover obscure replacement of primary native vegetation, 'compensated' by species-poor secondary regrowth that provides less suitable habitat for many native species. Lagged effects of clearing (extinction debt) also remain a concern (Keith and Auld 2017). Some threats (overgrazing by livestock and feral animals) remain insidious for a range of sensitive plants in some ecosystems (arid and semi-arid rangelands, alpine ecosystems). This threat drives long term decline and loss of habitat and vegetation structure. In these cases, effective threat abatement is needed over decadal time scales (Auld and Keith 2009) to avoid both the further loss of keystone trees species in these ecosystems and associated trophic losses of other biodiversity.

On a more positive note, at least for some threats and in some locations, there have been successes in reducing threat impacts in the past 30 years. Frameworks for managing adverse impacts of high fire frequency on threatened plants and ecological communities are factored into fire management in several jurisdictions (e.g., NSW RFS Environmental Code, [https://www.rfs.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0017/24335/Web-Version-ThreatenedSpeciesHazardReductionList-Part1-Plants-06-04-2017.pdf](https://www.rfs.nsw.gov.au/__data/assets/pdf_file/0017/24335/Web-Version-ThreatenedSpeciesHazardReductionList-Part1-Plants-06-04-2017.pdf)), although there is much more to do. Effective weed and pest mitigation on islands with high levels of plant endemism (Lord Howe Island and Norfolk Island) illustrate what can be achieved.

## Policies, Legislation and Regulation

The last 30 years has seen the introduction of national and state/territory legislation to identify and protect threatened species. We now have a national agreement that all threatened species listings will follow global best practice criteria (IUCN Species Red List criteria) under the Common Assessment Method (<https://www.awe.gov.au/environment/biodiversity/threatened/cam>). More work is now needed to make the threatened species and ecological community lists comprehensive and up to date.

The other major component to appear in legislation/regulation is the concept of 'offsets'. Offsets were intended as a last resort measure, for residual impacts after deployment of avoidance and minimisation measures. Implementation of offsets in Australian policy and legislation has not met global best practice (Maron *et al.* 2015), particularly the failure to ensure pre-requisite proper avoidance and minimisation measures, lack of an ultimate limit to loss for any threatened species or ecological community, lack of a requirement for additivity (cf. protection of land that was not likely to be lost), a lack of a requirement for like for like (a species



Cloud Forest on Mt Gower Lord Howe Island now has a chance to recover after removal of exotic rodents. Photo: Tony Auld

can be lost but compensation is provided for other species or biodiversity), and the temporal mismatch of years to decades between immediate, certain losses and any speculative, uncertain compensatory gains. Unfortunately, environmental legislation and regulation is often considered 'green tape' that 'gets in the way', rather than a means of sustaining natural capital and ensuring that development plans follow options that protect plants, animals and ecosystems. This is recognised globally in the new initiatives from the post-2020 global biodiversity framework which includes the need to "redirect, repurpose, reform or eliminate incentives harmful for biodiversity in a just and equitable way...".

## Restoration

Given the extensive loss, fragmentation and degradation of habitat in Australia, restoration of ecosystems is an important part of ongoing plant conservation. We have just entered the UN Decade on Ecosystem Restoration and the Darwin Agreement (Armitage *et al.* 2021) reflects a response from organisations involved in restoration in Australia to support the UN initiative by promoting best practice restoration, a common purpose, public awareness and engagement with communities, policy makers and industry. We now have national standards for ecological restoration (McDonald *et al.* 2016) and updated sets of best practice management to guide restoration components (Translocation, Germplasm and Florabank Guidelines, see above). Other necessary components are still lagging, including a sustainable seed supply chain (Hancock *et al.* 2020) and fully integrating ecosystem dynamics (including responses to disturbance regimes) into restoration targets and Key Performance Indicators.

In summary, the last 30 years has seen steady progress in understanding which plants and vegetation communities are most at risk or in decline (and legislating for their protection). New initiatives are emerging to fill conservation gaps and a range of best practice guidelines are available. However, the range and extent of many threats continues to grow and with a changing climate this will only be exacerbated. Clearly expressed in the post-2020 global biodiversity framework is the need to "Increase financial resources from all sources" to allow more effective plant conservation. The framework components for plant conservation are available, but we need an enhanced commitment from governments and support from the broader community to rapidly address the threat mitigation needed to give Australian plants the best chance of surviving into the future.

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# Retrospectives and perspectives on plant conservation in Australasia

Here we continue the series initiated in the summer 2021–2022 issue of APC, asking members of the Australasian plant conservation community:

*“What were you doing in 1991 and what are you doing now? How things have changed in the past 30 years.” and/or “What are the past, current and emerging issues for plant (or biodiversity) conservation in Australia (or Australasia)?*

Heidi Zimmer, APC editor

## Tricia Hogbin

In 1991 I had just started an undergraduate degree in biology; the first step towards a longed-for career in nature conservation. Fast forward a couple of decades and I realised my work in threatened species conservation (and indeed anyone's efforts to minimise biodiversity loss or climate change or pollution and so on) will

be futile unless humans lose our naive and selfish materialistic ways. I was coordinating recovery programs for threatened plants and would be trying to protect or restore habitat in one location while it was still being cleared in another. I felt as effective as a cleaning lady trying to sweep the floor in the midst of a wild party. One of the greatest challenges for plant conservation today, just as it was thirty years ago, is apathy.



Most people tend not to care about threatened plants. They cannot see the connection between biodiversity loss and their wellbeing and perceive 'nature' as an abstract thing that is elsewhere. These days I host nature connection gatherings for women and strive to inspire people to rethink the way they live through my writing. My nature memoir *Greenhood* (to be published early 2022 under the pseudonym Tricia D. Walker) is named after a threatened plant and I hope inspires people to deepen their connection with nature. We need people to care about their environment and to be more conscious of their impact on it.



For our plant conservation efforts to be effective we need people to connect with and care about their environment. A group of women during a facilitated nature connection activity. Photo: Tricia Hogbin

## Cathy Offord

Australian PlantBank, Australian Institute of Botanical Science

When I was first posted as a scientist at the Australian Botanic Garden in 1989 it was at a crucial time in the development of the national thinking about plant conservation. Initially my role was to explore the horticultural development of Australian native species, working with the cut-flower and nursery industries.

Working on waratahs and flannel flowers as export crops, soon turned into an exploration of understanding and exploring the diversity of these species and conserving them through seed banking, tissue culture and cultivation. At a conference in Canberra in 1990 an overwhelming case was made to establish a network to foster greater focus and collaboration on conservation issues, a turning point for me and many others. At that time there had already been a substantial amount of work done by Mark Richardson, Lyn Meredith and others at ANBG to guide our work as well as the inspirational programs at King's Park and Botanic Garden lead by Kingsley Dixon. These leading lights informed and guided us to develop our own conservation programs mostly through the conduit of the ANPC. I owe my own development as a conservation scientist, and the development of the Australian PlantBank integrated conservation facility in NSW, to the fostering by ANPC in ways too numerous to recount for this article. I am proud to have served on the national committee of ANPC, convened the 2008 national conference at Mulgoa, and to have worked with so many amazing people to produce articles for this journal and as well as various revisions of the national conservation guidelines. I wish the ANPC a happy 30<sup>th</sup> and look forward to many more productive ANPC interactions.



My 'Mr Curly' bag, a souvenir of the first ANPC conference in Hobart in 1993. While it is faded from many phytosanitary washes, it is still going strong and accompanies me on every plant collecting expedition. Photo: Cathy Offord



# Cryopreserving plants for long-term conservation

BRYN FUNNEKOTTER<sup>1,2\*</sup> AND ERIC BUNN<sup>1,2</sup>

<sup>1</sup> Curtin Medical School, Curtin University, Perth, WA 6102, Australia

<sup>2</sup> Kings Park Science, Department of Biodiversity, Conservation and Attractions, Perth, WA 6005, Australia

\*Corresponding author: B.Funnekotter@curtin.edu.au

## Cryopreservation

The ability to store germplasm in a viable state for extended periods of time is vital for many conservation programs, giving time for the development of research programs into understanding the species, as well as time for the development of successful translocation programs. Storing seed in seed banks is an excellent way of conserving germplasm; however, it is limited to species that produce sufficient orthodox seed (*i.e.*, seeds that tolerate drying and storage at -20°C).

A recent focus on the conservation of 'exceptional species' has highlighted the need for alternative storage techniques – with cryopreservation providing the best long-term *ex situ* storage solution applicable to a wide range of germplasm, including seeds, seed embryos, tissue culture material, spores, pollen and mycorrhizal fungi.

The very low temperatures of liquid nitrogen (-196°C) used in cryopreservation cause the chemical reactions in the cells to slow to such an extent that they are in essence halted, as the cellular contents vitrify (become an amorphous glassy solid). As long as the storage temperature remains stable, the samples show very little degradation over time.

## Cryopreserving Australian plant species

The first published report on successfully cryopreserving an Australian species was done on *Grevillea scapigera* shoot tips, a rare and threatened species in Western Australia (Fig. 1, Touchell *et al.* 1992). While only 20% survival was achieved in this study, it provided a proof of concept that cryopreservation is a viable storage method. Cryopreservation has now been successfully applied to seeds, seed axes, spores, protocorms, mycorrhizal fungi, callus tissues and shoot tips from 145 Australian species (see Table 10.4 in the Germplasm Guidelines for more details; Martyn Yenson *et al.* 2021). However, there are currently only two facilities in Australia focusing on cryopreserving threatened species for *ex situ* conservation – the Australian PlantBank (Australian Institute of Botanical Science, Royal Botanic Gardens and Domain Trust) and Kings Park Science (Department of Biodiversity, Conservation and Attractions, located at Kings Park and

Botanic Garden) – it would be great to see additional locations add cryopreservation facilities, and expand the work currently being done to conserve unique Australian plant diversity.

## Cryopreservation at Kings Park Science

The initial cryopreservation work in 1992 kicked off a range of projects at the research laboratory in Kings Park, testing the viability of seeds and tissue culture material of Western Australian species through cryopreservation. While many species from Western Australia have had their seed cryopreserved, a particular focus at Kings Park Science has been on developing cryopreservation protocols for the long-term storage of the species conserved using tissue cultured material (Fig. 2).



Figure 1. *Grevillea scapigera* growing in tissue culture at Kings Park Science. Photo: B. Funnekotter



Figure 2. Tissue culture room at Kings Park Science. Photo: B. Funnekotter

Tissue culture is a valuable conservation tool, especially for exceptional species from small populations where genetic diversity can be very limited, hence as much of the genome as possible needs to be conserved by clonal accessioning material from each remaining plant by cutting propagation and later establishment of tissue cultures from cutting-grown plants; or establishment of tissue culture lines from shoot material direct from wild plants. However, tissue culture can be difficult and time-consuming, starting with establishment of cultures (especially when using wild sourced material). Once culture lines are established, they require labour intensive on-going maintenance, which entails subculturing the multiplying shoots onto fresh medium at regular intervals (Fig. 1) Additionally, if kept in tissue culture for extended periods (many hundreds of culture cycles over many years), the species may undergo somaclonal variation and no longer remain true-to-type. Cryopreservation of shoots avoids the need for maintaining long-term culture lines and provides the best available long-term storage solution.

The Kings Park Science cryopreservation collection for tissue-cultured species currently holds 37 species in liquid nitrogen, with 117 clonal accessions and a total of 7,700 shoot tips cryopreserved. This represents about half of the clonal accessions in the tissue culture room backed up in cryo-storage, with the aim to have a long-term backup for all the species in the tissue culture collection that can be re-warmed as required in the future (Figs. 3 and 4).

### Cryobiotechnology research

Developing cryopreservation protocols for new species can be a long, time-consuming process, with many species requiring optimised exposure to desiccation medium, cryoprotective agents and unique concentrations of plant growth regulators in the recovery medium (Streczynski *et al.* 2019). Cryobiotechnology research aims to understand the fundamental science behind successful cryopreservation, leading to new, more efficient and widely applicable cryopreservation procedures.

Even small optimisations can significantly improve survival rates after cryopreservation, as seen with the switch to a droplet vitrification method that increases the cooling and rewarming rates when transferring samples into and out of liquid nitrogen. Species like *Grevillea scapigera* saw their survival rates increase to 79% using droplet vitrification, up from 50% when compared to older cryopreservation methods and the 20% survival seen in the very first trials cryopreserving this species (Touchell *et al.* 1992 and unpublished data).

Research currently being conducted at Kings Park Science into cryobiotechnology is looking at a wide range of factors to improve success for Australian species (Streczynski *et al.* 2019), from new cryopreservation procedures that reduce the physical handling of the sensitive shoot tip material (Funnekotter *et al.* 2017a), how oxidative stress can affect post-cryogenic survival



Figure 3. Liquid nitrogen dewars at Kings Park Science holding cryopreserved germplasm, including seed, symbiotic mycorrhizal fungi for orchid seed, and shoot tips. Photo: B. Funnekotter



Figure 4. Dr Eric Bunn and Dr Bryn Funnekotter transferring samples into the main liquid nitrogen dewar. Photo: R. Campbell

(Funnekotter *et al.* 2017a), and new research into how metabolic rate is affected by cryopreservation and plant growth regulators. More information about the whole cryopreservation process can be found in Chapter 10 of the Germplasm Guidelines (Martyn Yenson *et al.* 2021).

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# Conserving priority species at the Australian National Botanic Gardens

KATHRYN SCOBIE

Australian National Botanic Gardens Nursery  
Corresponding author: [Kathryn.Scobie@awe.gov.au](mailto:Kathryn.Scobie@awe.gov.au)

Botanic gardens have an increasingly important role in the conservation of native flora. In recent years, the Australian National Botanic Gardens (ANBG) has increased its focus on the conservation of threatened species. This has included a diverse range of collaborative projects, growing plants for genetic and other scientific research, seed orcharding, translocation projects, revegetation work and *ex situ* collection development and management. The ANBG's living collection, held in the Gardens, Nursery and National Seed Bank, currently represents almost a third of all threatened flora listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Below we outline some recent projects and initiatives that demonstrate the ANBG's increasing focus on contributing to conservation efforts.

## Ranking species helps focus plant conservation efforts

The ANBG has developed a new system for prioritising plants in the living collection (Martyn Yenson *et al.* 2021, Chapter 2), to ensure persistence of species with higher conservation value. Plant species are ranked according to criteria including threat status (state and national listing) and other factors impacting their extinction risk. This ranking is now applied to all accessioned plant records in the living collection database, enabling significant advances to our priority species management, including:

- Informing a significant overhaul to the permanent potted collection in the ANBG Nursery, which now prioritises holdings of threatened species if there is uncertainty about their long-term survival in planted collections in the Gardens.

- Informing an ongoing propagation plan for the living collection, with a focus on producing and maintaining high priority species.
- Ensuring high conservation-value species are given appropriate consideration when being planted, in terms of their location in the Gardens and their ongoing requirements for successful establishment.
- Empowering all horticultural staff to focus their daily management and maintenance efforts on the most valuable plants in the collection, by making the rankings available through the database, which is easily accessed via mobile device while out working in the Gardens.

## Potential threats elevate priority of unlisted species

One of the factors that contributes to the priority ranking allocated to a species is its potential exposure to destructive stochastic events, like bushfire. The ANBG is currently engaged in two collaborative projects supporting the recovery of species impacted by the 2019/2020 bushfires in south-eastern Australia. This work highlights the necessity of conserving plants that may not already be listed under state or national legislation.

## Sub-alpine species conservation

This 3 year project, aptly named *Survive and Thrive*, will focus on post-fire recovery and climate change resilience for threatened plant species in sub-alpine south-eastern Australia. Working together with many project partners from across Australia, we will use botanical science and horticultural methods to support recovery of threatened

plant species from Namadgi National Park and adjacent alpine National Parks in NSW and Victoria, which were severely impacted by the 2019-20 bushfires. The project, established by the National Parks Conservation Trust, is supported by a private donor, World Wide Fund for Nature, the Australian Alps National Parks Cooperative Management Program, the Australian National Botanic Gardens, the NSW Department of Planning and Environment (DPE), the ACT Government Environment and Sustainable Development Directorate and a strong network of Canberra volunteers.

The ANBG will contribute through building knowledge on the ecology, cultivation and propagation requirements (both seed and vegetative) of five target species: *Leptospermum namadgiense*; *Almaleea capitata*; *Viola improcera*; *Olearia* sp. *Rhizomatica* (I.R.Telford 11549); and *Leionema lamprohyllum* subsp. *obovatum*. The broader project will target 12 species in total. These species were selected in part because of the lack of knowledge about their biology and ecology, including seed dormancy and germination cues, and cultivation and regeneration requirements. The National Seed Bank will collect and store seed from all target species found, and investigate their germination requirements and seed biology.

The ANBG will establish and publish outcomes of horticultural research, including the propagation techniques required for each species. This important information will inform future propagation efforts of these species, should their wild populations not recover



Work is underway studying sub alpine target species at the ANBG nursery. Photo: Carol Dale, ANBG



*Leionema lamprohyllum* subsp. *obovatum* in cultivation at the Australian National Botanic Gardens. Photo: Carol Dale, ANBG

from the bushfires and translocation or enhancement plantings become necessary. It will also enable seed production, if we cannot sustainably collect enough wild seed to secure the species adequately in seed bank storage. The nursery will also propagate material from multiple populations of each species so that genetically robust *ex situ* conservation collections can be established within the Gardens.

For more information see: [https://parkstrust.org.au/unique-projects/survive\\_and\\_thrive/](https://parkstrust.org.au/unique-projects/survive_and_thrive/)

### Mt Imlay endemic species conservation

Slightly further afield at Mt Imlay National Park, near Eden, on the far south coast of NSW, the ANBG is contributing to collaborative conservation of several highly threatened endemic species. Mt Imlay National Park supports a very unique suite of endemic rare and threatened plants and is managed with great care by the NSW National Parks and Wildlife Service (NPWS). Mt Imlay has just recently been declared an Asset of Intergenerational Significance (AIS) which affords it priority management status. Mt Imlay was severely burnt in the 2019-20 bushfires and threatened flora experts from DPE, with support from NPWS colleagues have monitored fire-affected endemic plants on three occasions since the fire event.

The most recent field surveys undertaken in 2021 by DPE South East botanists found that the entire adult population of two fire-sensitive endemic species, *Hibbertia circinata* and *Boronia imlayensis*, had been burnt in the 2019-20 bushfires. Both species are found only on the summit of Mt Imlay in Mount Imlay National Park. Thankfully, many new seedlings emerged in 2021 following good post-fire rains. However, with no mature seed-producing plants in the wild, both species are vulnerable to extinction should these developing seedlings fail.



In response, DPE and ANBG developed an urgent plan to collect and secure seedlings of both species, with the seedlings to be distributed between the ANBG and Booderee Botanic Gardens (BBG), providing the additional safeguard of two separate *ex situ* collections. Staff from DPE South East Threatened Species team and BBG were able to conduct an urgent collection trip to Mt Imlay, with ANBG staff unable to attend due to Covid-19 restrictions. Together, they undertook field surveys and collected around 60 seedlings of each of the two species, which are currently being grown in the nursery at BBG. Once border closures are relaxed, half of these will be transferred to the ANBG Nursery, at which time, both botanic gardens will house genetically diverse *ex situ* collections of the two species.

Once the plants at BBG have developed sufficiently, many will be planted out into the grounds as part of the botanic garden's living collection. Canberra's less favourable climate means the ANBG collection will initially remain in the controlled environments of the Nursery, where work will focus on optimising propagation techniques, particularly for *Boronia imlayensis*. Due to the significance of the Mt Imlay area (outlined above), the ANBG has been supporting conservation efforts and investigating propagation techniques of species endemic to Mt Imlay for many years. Nursery staff have already had good propagation and cultivation success with *Hibbertia circinata*, and the species has been successfully grown in the ground at the ANBG. *Boronia imlayensis* however, has presented a more significant challenge, and has been extremely difficult to reliably propagate and cultivate. This conservation project will provide the much-needed opportunity for the ANBG Nursery and the National Seed Bank to undertake further important work into the propagation and seed biology of this beautiful and endangered species.

## Adapting to change

While these two examples are a snapshot of the many conservation projects in progress at the ANBG, they illustrate the need for plant conservation work to be dynamic and flexible in response to current environmental needs, threats and restrictions. By collaborating with others, maintaining excellence in horticulture and research, and being able to adapt to changing requirements, the ANBG will continue to strive for excellent conservation outcomes for Australia's threatened flora.

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Growing *Hibbertia circinata* in the Booderee Botanic Gardens Nursery. Photo: Julie Percival, BBG



*Hibbertia circinata* regrowth at Mt Imlay National Park. Photo: Julie Percival, BBG



The view from Mt Imlay, with Senior Threatened Species Officer Genevieve Wright from NSW Department of Planning and Environment. Photo: Julie Percival, BBG



# Why Australia needs an Ecosystem Restoration Strategy

LUCY E. COMMANDER<sup>1,2\*</sup>, AMELIA J. MARTYN YENSON<sup>1,3</sup>, DAVID J. COATES<sup>1,2</sup>, KEITH BRADBY<sup>4</sup>, BOB MAKINSON<sup>1</sup>, CATHERINE A. OFFORD<sup>3</sup>, LINDA BROADHURST<sup>1</sup>, TONY AULD<sup>1</sup> AND PAUL GIBSON-ROY<sup>5</sup>

<sup>1</sup>Australian Network for Plant Conservation.

<sup>2</sup>The University of Western Australia, Crawley WA 6009.

<sup>3</sup>The Australian PlantBank, Australian Institute of Botanical Science, Australian Botanic Garden, Mount Annan NSW 2567, Australia.

<sup>4</sup>Gondwana Link, Albany WA 6332.

<sup>5</sup>Western Sydney University.

\*Corresponding author: [drLucycommander@gmail.com](mailto:drLucycommander@gmail.com)

Australia needs a national strategy for ecosystem restoration.

2021 marks the beginning of the United Nations Decade on Ecosystem Restoration<sup>1</sup> which aims to prevent, halt and reverse the degradation of ecosystems globally. In Australia, land use practices and invasive species are two of the most pervasive threats that have caused land degradation. We owe it to future generations of Australians to halt and repair as much of this environmental damage as we can, especially given the new and acute stresses that climate change is now imposing. Currently, degraded Australian ecosystems are being restored by organisations and individuals at local and regional scales, but with limited co-ordination and prioritisation at a national level, and a continuation (outside of reserves) of the same systemic settings of weakly restricted land-use regulation that allowed the damage to occur. Given the ‘global rallying cry’ to heal the planet, and to match efforts that will emerge in 2022 in the final agreed post-2020 Global Biodiversity Framework, now is the time to develop a national ecosystem restoration strategy for Australia.

Existing projects restoring ecosystems at the landscape scale provide examples that could be expanded or applied elsewhere. For instance, Gondwana Link<sup>2</sup>, Great Eastern Ranges Initiative<sup>3</sup>, Victorian Northern Plains Grasslands Protected Area Network, the Tasmanian Midlands Restoration Project<sup>4</sup>, and projects by members of Australian Land Conservation Alliance<sup>5</sup>.

Biodiversity conservation in Australia<sup>6</sup> has focused on both threatened species and ecological communities (*i.e.*, species and systems considered to be most at risk of extinction), along with conservation towards a representative set of ecosystems in the reserve network

and mitigating threatening processes. In contrast, ecological restoration (the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed; Gann 2019) is largely focused on ecosystems and landscapes under the assumption that habitat loss and land degradation are recoverable. Given the rising number of threatened species and threatened ecological communities, and the limitations of the reserve network, Australia also needs coordinated restoration that is integrated with conservation that includes all stakeholders to overcome any disconnect between those doing ‘conservation’ and those doing ‘restoration’. A similar gap also exists between research and practice, with the Australian Network for Plant Conservation (ANPC) working hard to facilitate communication between all of these groups.

Like the disconnect between conservation and restoration, plants and animals may also be focused on separately rather than together. For instance, many plant biologists complain about ‘plant blindness’ (Balding and Williams 2016) – that is, the tendency of people to focus on threatened animals, particularly charismatic fauna (*e.g.*, koalas, bilbies, whales, black cockatoos). Whereas restoration programs often concentrate on establishing/returning a basic suite of plant species or removing a threatening process (*e.g.*, invasive plant control), animal biologists bemoan the fact that fauna is routinely left out of restoration projects (Woinarski 2021; Cross *et al.* 2020). By considering ecosystems and landscapes as a whole, we have the opportunity to both conserve threatened species (flora and fauna), as well as restore the ecological communities and processes (such as pollination) on which they depend.

1 <https://www.decadeonrestoration.org/>

2 <https://gondwanalink.org/>

3 <https://ger.org.au/>

4 <https://www.bushheritage.org.au/places-we-protect/tasmania/midlands>

5 <https://alca.org.au/members/>

6 <https://www.awe.gov.au/environment/epbc/what-is-protected/biodiversity-conservation>

While government funding at all levels has been one of the key drivers, restoration has also been funded by private entities (e.g., for carbon credits), the resource industry undertaking restoration as part of conditions set by government, and NGOs. However, some funding programs look at each individual project on its merits, devoid of wider context. Many programs do not consider the continent as a whole and fail to prioritise ecosystems and/or landscapes where the need is greatest, or where interventions could make the most difference. Historically, restoration funding has overwhelmingly favoured simplistic tree and shrub plantings (e.g., 20 million trees), rather than returning the structure, function and diversity unique to each ecosystem. They also ignore the potential of other approaches such as natural or assisted regeneration (which includes the management of invasive plants and feral animals; Figure 1). Perhaps it is because inputs (e.g., number of trees in the ground) are easier to measure in the project time frame than outputs (e.g., long term survival and improved ecosystem function)? Despite calls for large-scale restoration in highly degraded landscapes (Mappin *et al.* 2021) a further and more serious consequence of this long-term focus on low diversity restoration is that the restoration sector itself has very poor capacity to undertake these works (Gibson Roy *et al.* 2021b).

## What do we need?

### 1. A prioritisation of where and how to restore.

Prioritisation tools to determine where and how to restore could focus on a variety of parameters, including (but not limited to):

- Identifying which ecosystems are most stressed.
- Establishing essential linkages in highly fragmented landscapes (so long as the linkages do not accelerate the movement of threats).
- Providing habitat for threatened species.
- Providing conservation benefits for survival and persistence of different ecosystems and species.
- Identifying places where there are the biggest opportunities.
- Improving ecosystem services (e.g., combatting salinity, improving clean water, carbon sequestration, urban heat mitigation, microbiome, human health benefits (mental and physical), flood mitigation, sediment trapping, increasing aquifer recharge, increasing pollination, increasing rainfall through increased evapotranspiration etc.).

Another priority is to better understand where in Australia restoration is being done well, and determine firstly what success factors are to do with bio-physical

advantages, and what are the results of better practice – and then to generalise the latter to other areas if possible. This needs to be balanced with investigation of lower-success regions or approaches to determine the reasons, recognising that all areas need some investment. Also, ‘failures’ can be a result of innovation, and if well documented, can lead to adaptive management.

To inform planning, knowledge about the combination of restoration approaches (e.g., seeding, planting, threat mitigation, replacing natural disturbance regimes; Figure 1) that are most effective for particular species and contexts is required to improve the likelihood that funding will be cost-effective and produce successful outcomes. Certainly, one lesson coming from current approaches is that any prioritisation at scale needs to include a degree of ‘discretionary opportunism’ – where support, or lack of opposition, from local communities is a factor, along with availability of various funding streams, and where property acquisition is a mechanism, market conditions and the relative priority of other land uses.

Planning and prioritisation requires the compilation of baseline ecological data at a variety of scales using multiple methods, to augment existing information collated by the State of the Environment Report<sup>7</sup>, Atlas of Living Australia<sup>8</sup>, TERN<sup>9</sup>, NSW Bionet<sup>10</sup>, and others.

### 2. Connect efforts to conserve threatened species, mitigate threats and restore ecosystems.

While there has been the view that restoration ecology is a discipline in its own right with philosophical and operational differences from conservation biology (Young 2000), it is becoming increasingly clear that an integrated approach is needed to maintain and restore biodiversity. Plant and animal species are often threatened due to habitat loss. Working in collaboration to both restore habitat and increase the number of individuals of threatened species would provide significant benefits. For instance, where feasible, threatened plant species can be included in ecological restoration projects (as seed or as tubestock). Recovery teams, government agencies and NGO groups undertaking threatened species translocations or seeking to improve habitat condition for threatened species could connect with organisations undertaking ecological restoration, including threat mitigation. Single and multi-species recovery plans, conservation advices, threat abatement plans, translocation plans and planting schemes could all be interconnected at a regional level. These connections would create cost-sharing opportunities during both implementation and monitoring, as well as improving the species mix and create local information-sharing hubs of staff, volunteers and community members.

<sup>7</sup> <https://www.awe.gov.au/science-research/soe>

<sup>8</sup> <https://www.ala.org.au/>

<sup>9</sup> <https://www.tern.org.au/>

<sup>10</sup> <https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/nsw-bionet>

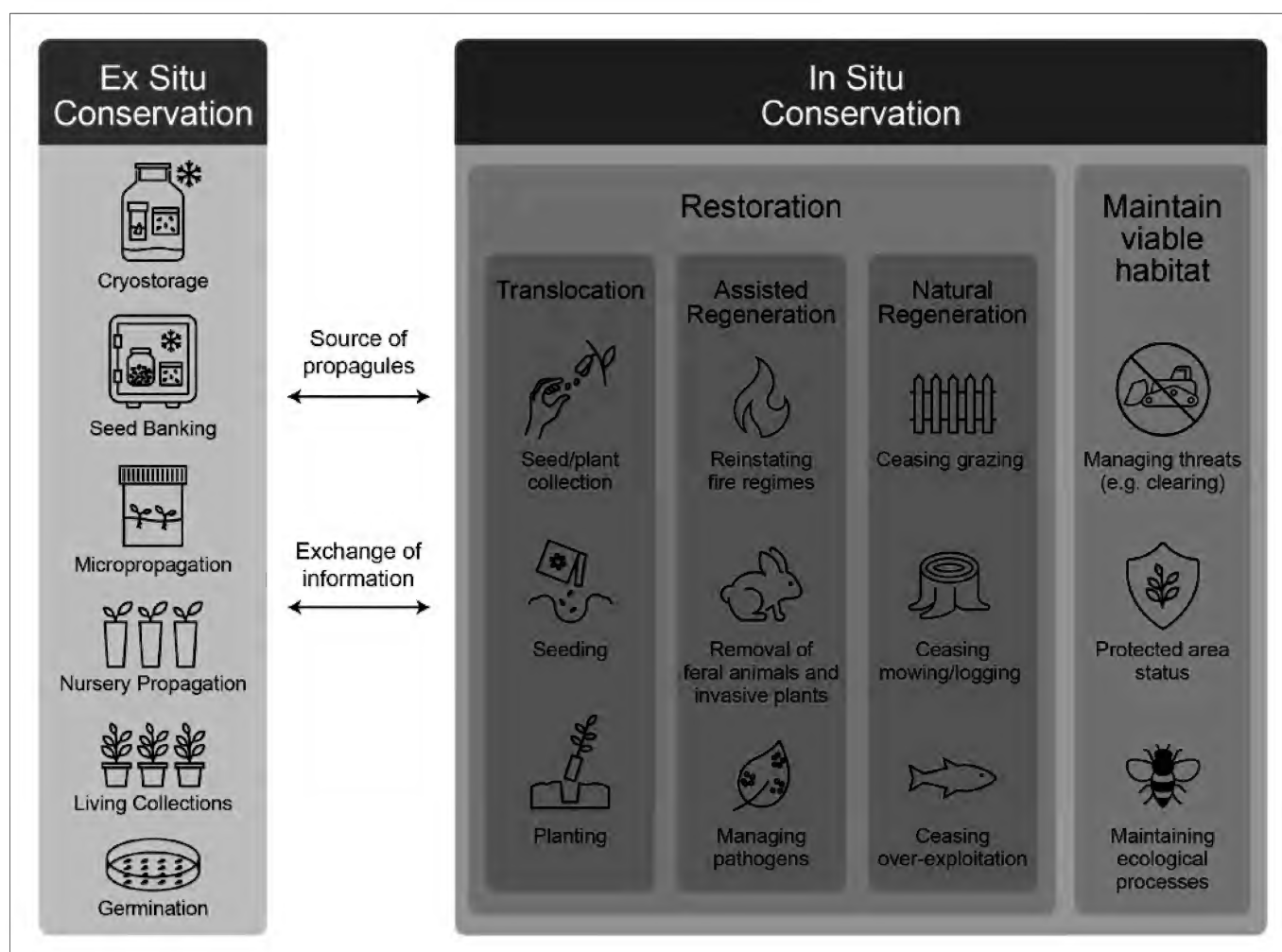


Figure 1. Is there really a difference between conservation and restoration? Is restoration an action within conservation? Or vice-versa? These sectors could be better connected. Image: Commander 2021a; Martyn Yenson *et al.* 2021; CAM graphics

The interconnected elements of both conservation and restoration are recognised in the recent editions of the Germplasm Guidelines (Martyn Yenson *et al.* 2021), Florabank Guidelines (Commander 2021a) and Translocation Guidelines (Commander *et al.* 2018) (Figure 1).

### 3. Re-think funding models.

Short-term grant rounds may be considered a necessity due to established budget cycles or allocated resources, but providing funding that must be spent within 1-3 yrs (as is typical with both private and government funding) is not ecologically sound or practical at an on-ground level. For instance, if land managers want to control weeds, a 5-7 year commitment may be required to deplete the seed bank. If land managers don't expect ongoing funding, they are unlikely to start a weed management program, because just doing one year will likely be a waste of funds.

Projects that involve seeding and planting require long timeframes (Dillon *et al.* 2018; Commander 2021a), and

can take at least one year to plan, and then several more to implement. Consistent advice from the seed industry is that to economically achieve a broad range of species for restoration plantings at large scale can take several years. Both collecting from the wild and developing seed production areas (SPAs) require long term planning. SPAs can help meet seed needs in large-scale restoration (Gibson-Roy *et al.* 2021a) but developing SPAs and establishing crops to full production can take up to five years. Collected seeds from either the wild or SPAs then need to be cleaned, and it can take six months or more to propagate seedlings if restoration is done by planting. Typical funding models are also often out of sync with Australia's seasonal changes. For instance, funding for WA's Community Stewardship Grants<sup>11</sup> (small grants are for just 18 months, larger grants are up to 3 years) are announced in October/November for projects commencing on or after 1 January, which is too late for people to order seed and/or seedlings for propagation and planting in July of that year (typical planting season in south-west WA).

11 <https://www.wa.gov.au/service/community-services/grants-and-subsidies/apply-community-stewardship-grant>

Nor does single year funding allow for the prior planning and resourcing of projects that may be needed to prepare for stochastic events such as bushfires, where it is prudent to have seed in storage, and have the ability to rapidly act to control post-fire weeds. In addition, not all species produce seeds each year, due to species-specific or climatic factors, hence single year funding may not allow for the anticipatory collection of these species when they are available and store them under conditions that maintain viability until they are required.

Most funding timelines do not allow for follow up maintenance and monitoring, and this needs to be included for a number of years after planting. Annual grant applications and the low likelihood of success in many of these is debilitating for the organisations and individuals involved. We suggest simplified EOI processes and robust final rounds would be an improvement to current processes, along with longer grant time frames and sensible reporting intervals to give practitioners more time for planning, implementing and following up on-ground activities and reduce the burden of office time seeking funds. Grant recipients should have up to a minimum of 5 years to spend these funds so that they can adequately plan and undertake activities to ensure success.

The scale of restoration needed across Australia requires an effort that stimulates greater expenditure from both public and private funding streams. A national strategy would need to address the issue of resourcing the scale of restoration needed.

#### **4. Spend money on capacity building to improve practices and outcomes**

Much restoration is done by landcare, coastcare, bush regeneration and community groups in urban bushland, who may be landowners or volunteers. Equally, restoration is also done by those in areas such as the mining industry, NRM sector, consultants and Main Roads Departments. These people may or may not have a background in restoration ecology, may not be trained in seed procurement, or understand the concepts of natural regeneration. We need to make sure that all these people and groups have access to the best knowledge and resources available.

We need to provide better resources for capacity building, at a national, state and regional level. Capacity building in relation to knowledge may be in the form of technical guidelines, fact sheets, face to face workshops, upskilling trainers or funding a knowledge broker who can connect people to publications or knowledge-holders then answer follow-up questions. However, the sector needs much more than improved information flow. To move beyond low diversity restoration, increased investment in infrastructure and restoration technologies

is required to enable the sector to develop the capacity to undertake landscape-scale restoration. Stronger markets for restoration would also mean practitioners are better paid for their work and we are more able to retain a skilled and motivated work force.

Equally, investing in training people seeking restoration qualifications from certificate to degree level makes good sense, equipping the next generation with the skills and knowledge they need to undertake restoration in a changing climate. Well-meaning 'environmental green jobs' programs of recent decades didn't really do this, they largely created short-term on-ground positions for unemployed or socially disadvantaged people. This short-term benefit often meant private practitioners were excluded from work (with many forced to leave the sector). Stable restoration markets would also create stable career paths so the sector could take on and retain a suitably trained, skilled and motivated workforce (rather than the current aging and poorly trained one).

Indigenous ranger programs and indigenous seed collection enterprises are opportunities for employment and the continuation of generations of caring for Country. A national restoration strategy should recognise and celebrate traditional ecological knowledge, provide local employment, and empower and build capacity in communities.

Who should do the capacity building? Providing separate grant programs for training so they are not competing with on ground works would be beneficial. In fact, capacity building and coordination is often ineligible for funding. Perhaps a national restoration training network with representatives from each state and sector (university, TAFE, government at all levels, landcare, NGOs, zoos, botanic gardens, mining, land development, carbon capture projects). A network could be responsible for collating information for on-ground needs, and connecting with experts who can deliver training to meet those needs. This would improve communication flow and knowledge-transfer. Also, synergising efforts to get the most out of a small workforce: those providing training can use restoration areas to train people (for instance, teaching staff at Murdoch University in Western Australia take students to a local restoration site<sup>12</sup> to teach them how to do surveys – it's a win-win situation as students receive practical training and the land managers receive the survey information).

Over the last 30 years, the Australian Network for Plant Conservation has played a role in capacity building through publications, workshops and conferences. Furthermore, the ANPC's Australian Native Seed Survey Report (Hancock *et al.* 2020) provides recommendations for building capacity across the sector.

12 <https://rehabilitatingroee8.org/wp-content/uploads/2019/07/Murdoch-University-Vegetation-monitoring-of-Roe-8-.pdf>

## 5. Develop regional restoration guidelines for planning, monitoring and ongoing management

Planning guidelines and templates that include checklists would assist practitioners to ensure that each restoration project consider and address all elements required for restoration, as well as the timeframe for each element. This would make it easier for funding bodies to assess the plan, though caution will be needed to ensure this can proceed over lengthy timeframes. There are templates for translocation proposals (Nally *et al.* 2018), so a suite of similar documents could be developed for restoration. Projects can follow the same decision-making process and proforma irrespective of the restoration approach (natural or assisted regeneration, planting or seeding) though timelines may be adjusted. Guidelines will then facilitate a process to determine the most appropriate approach, and if that approach is natural or assisted regeneration (which includes threat mitigation), then funds need not be spent on planting.

Regional Restoration Standards could follow the National and International Standards for Ecological Restoration (Standards Reference Group SERA 2021; Gann *et al.* 2019) and the Australian Translocation Guidelines (Commander *et al.* 2018), with the Florabank Guidelines (Commander 2021a) and Germplasm Guidelines (Martyn Yenson 2021) as supporting documents for sourcing seed and other plant material. Hence, with regional level strategising and synchronising of restoration needs, each region and restoration program could develop its own restoration planning document. These 'How To' guides could include specific advice on the local reference ecosystems, threatening processes, and how to implement various restoration approaches.

### Do related strategies already exist?

Various national strategies and plans exist. There is Australia's Strategy for Nature<sup>13</sup>, Threatened Species Strategy<sup>14</sup>, Threatened Species Action Plan Consultation Paper, Threat Abatement Plans<sup>15</sup>, National Vegetation Framework<sup>16</sup>, and the draft Strategy for the Australian Seed Sector<sup>17</sup>, but these could be better linked and supported by an overarching document outlining the direction for restoration. In addition, various legislation protects species and ecosystems, such as the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and a range of legislation for each State and Territory (see Florabank Guidelines Module 3 (Cuneo *et al.* 2021) for list of state and territory legislation). Additionally, a number

of private organisations have developed strategic approaches across priority areas (such as Gondwana Link and Great Eastern Ranges) or to match specific funding opportunities (such as for large scale carbon sequestration).

Other countries have national or regional strategy documents (Commander 2021b), such as the USA's National Seed Strategy for Rehabilitation and Restoration 2015–2020 (Plant Conservation Alliance 2015), EU Biodiversity Strategy to 2020<sup>18</sup>, Finland's Saving Nature for People<sup>19</sup>, and Biodiversity 2020: A strategy for England's wildlife and ecosystem services<sup>20</sup>.

However, there is no national strategy in Australia to provide the support needed for co-ordinated and prioritised restoration of degraded ecosystems across the country which is integrated with conservation of species and places.

## Summary

So, what do we need in the National Restoration Strategy?

- Where – a prioritisation of where we need to restore ecosystems, as well as a comprehensive list of all places in need of restoration, rather than an ad-hoc approach to restoration.
- What – baseline data on the current state of the ecosystems and information on reference communities so goals and targets can be established for individual restoration projects. A focus on restoring biodiverse ecological communities, rather than just single species replacement or simplistic, low diversity plantings.
- How – recognition and funding of different yet complementary approaches for restoration – natural regeneration, assisted regeneration, translocation, and complementary actions such as *ex situ* conservation, and identification of the appropriate approach(es) for each context. Publication of guidelines for these approaches, as well as guidelines for scaling up approaches, *e.g.*, large scale direct seeding. Some of these guidelines exist, however, regional guides with location-specific information and knowledge brokers are likely to be required. Investment and capacity building to enable landscape-scale restoration.
- Who – both a ground up and top down approach. We need to identify all of the actors including those on ground, those involved in education and training, policy and governance, large networks and associations. We need experts in conservation prioritisation, environmental economics,

13 <https://www.awe.gov.au/environment/biodiversity/conservation/strategy>

14 <https://www.awe.gov.au/environment/biodiversity/threatened/publications/threatened-species-strategy-2021-2031>

15 <https://www.awe.gov.au/environment/biodiversity/threatened/threat-abatement-plans>

16 <https://www.awe.gov.au/agriculture-land/land/publications/australias-native-vegetation-framework>

17 <https://www.greeningaustralia.org.au/wp-content/uploads/2021/08/3.01.pdf>

18 [https://ec.europa.eu/environment/nature/biodiversity/strategy\\_2020/index\\_en.htm](https://ec.europa.eu/environment/nature/biodiversity/strategy_2020/index_en.htm)

19 <https://ym.fi/en/national-biodiversity-policy>

20 <https://www.gov.uk/government/publications/biodiversity-2020-a-strategy-for-england-s-wildlife-and-ecosystem-services>



landscape-scale restoration, threatened species and communities, volunteer management, baseline assessment of ecosystems, restoration practitioners, and *ex situ* conservation. Using this collective expertise, and a co-ordinated approach, we could develop and enact a comprehensive plan if funding is available.

- Why – identify and communicate all the benefits of restoration: decreasing extinction risk, improving ecosystem services, providing economic benefits (e.g., ‘forest products’ and employment) and contributing to fulfilling international obligations such as the UN Convention on Biological Diversity’s (CBD) Post-2020 Global Biodiversity Framework and Global Strategy for Plant Conservation; and the Paris Agreement.
- When – now, but also a long-term plan (10 years and beyond) to capitalise on the UN Decade on Ecosystem Restoration and the CBD 2050 Vision for Biodiversity. Individual restoration projects require sufficient time for adequate planning, preparation, implementation, monitoring, adaptive management and reporting.

Australia needs a national strategy for ecosystem restoration. With 30 years of the Australian Network for Plant Conservation, let’s develop a national strategy to restore our ecosystems over the next decade, so in the 40<sup>th</sup> anniversary edition, we can reflect on our positive, collaborative contribution.

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Editor’s note: this article was submitted in 2021, hence some information may be out of date by the time of publication. The author would like to thank the input of several reviewers.

# Historical settler interest in the use of fire to restore the degraded indigenous vegetation communities of colonial Melbourne

PETER ARDILL

Independent researcher of Australian environmental repair history. Leura, NSW.

Corresponding author: p\_a\_7@bigpond.com

## Introduction

Walter Froggatt (commencing in 1930), Ambrose Crawford (from 1935) and Albert Morris (from 1936) are considered to be the earliest settler proponents in Australia of environmental repair that aspired to the reversal of degradation within a specific site. However, new research reveals that, from 1896, settlers instigated environmental repair projects in colonial Melbourne. Controlled fire was promoted as an effective means of restoring multiple indigenous vegetation species to degraded ecosystems (Ardill 2021).

## Eastern Kulin management

Prior to British invasion in 1835, communities of the Eastern Kulin nation managed homelands that encompassed Nairn (now also known as Port Phillip Bay). At this time, the indigenous vegetation of the extended foreshores and dunes of the Nairn east coast prominently featured Coast Teatree (*Leptospermum laevigatum*), Coast Wattle (*Acacia longifolia* and *A. longifolia* subsp. *sophorae*), Coast Banksia (*Banksia integrifolia*) and Drooping Sheoak (*Allocasuarina verticillata*) (Presland 2005: 170). Today, these species continue to characterise the major vegetation communities of the eastern Port Phillip Bay foreshores: Coastal Dune Scrub, Coastal Headland Scrub and Coast Banksia Woodland (DSEV 2007).

At the time of Eastern Kulin management, it is quite possible that fire, either in the form of wildfire, or Kulin cultural fire, or both, played a significant role in the renewal of the east coast foreshore vegetation communities. The first Europeans to view Nairn noted extensive fire impacts throughout the landscape. For example, in 1803 William Crook recorded that 'Perhaps a tenth part of the trees are burnt' (Gammage 2011: 259).

That wildfire had capacity to facilitate the natural regeneration of many of the east coast vegetation species was demonstrated by a ca.1910 foreshore wildfire at Beaumaris. The fire 're clothed' the site with 'dense scrub growth, more varied, more attractive, than in its original state' (Macdonald in Ardill 2021: 23).

Gammage (2011) maintains that the Nairn landscapes were a product of cultural fire, 'a boundless estate, a lesson in utility and beauty'. Certainly, a cultural fire regime had potential to foster the ecological persistence of Coast Teatree and its associated vegetation communities. Vegetation species' diversity and plant density within Sydney Eastern Suburbs Banksia Scrub, characterised by Coast Teatree and Wallum Banksia (*Banksia aemula*), was significantly promoted by a controlled burn of varying intensity (Lambert 2015: 98). Eastern Kulin communities were known to apply fire at staged intervals to generate a regular supply of the edible tuber Murnong (*Microseris lanceolata*), and fire managed grasslands and woodlands facilitated hunting and travelling (Presland 2010: 72).

## Coast Teatree degradation and restoration

Following British colonisation of Nairn, renewal of Coast Teatree and other foreshore indigenous vegetation species and communities was quite possibly set back by a decrease in fire events. Cultural fire practice ceased as Eastern Kulin communities were dispossessed. Melbourne grew rapidly, and possibly foreshore wildfire outbreaks were contained, and became less common. Certainly, widespread senescence of Coast Teatree communities was being reported by ca.1900. Also, detrimental settler recreational impacts along the beaches and dunes, stock grazing and firewood collection resulted in degradation of many foreshore vegetation communities (Ardill 2021).

The shady groves of attractive Coast Teatrees were popular beach picnicking and camping spots, and their ongoing degradation and the resultant loss of amenity and economic benefits created alarm in resort towns like Brighton and Mornington (Figure 1). Responding, in 1896 Brighton Council initiated Coast Teatree replanting projects within degraded foreshore reserves (Ardill 2021). These projects were regarded as highly experimental, and council administrative and horticultural staff were very pleased when the seedlings thrived. Other Bay councils undertook similar projects to save their Coast Teatree groves, with good results.

Concerned community groups became involved from 1903, replanting thousands of Coast Teatrees in degraded foreshore reserves. A particularly interesting community replanting project took place at Beaumaris between 1924 and 1927. In a move that resembled contemporary Bushcare and Landcare practices, residents joined forces with the shire council and conducted Coast Teatree replanting sessions throughout the winter months. Residents took responsibility for sections of the foreshore, and the council supplied plants and equipment (Ardill 2021: 25). At Mornington, natural regeneration of Coast Teatree was actively fostered by community volunteers in the 1920s.

Melbourne journalist, nature writer and conservationist, Donald Macdonald, vigorously campaigned between 1910 and 1930 for the repair of degraded foreshore reserves. A keen ornithologist, he perceived the ecological need to reinstate a range of foreshore plant species, as well as the Coast Teatree.

Macdonald absorbed the restoration lessons illustrated by the ca.1910 Beaumaris wildfire. The fire demonstrated 'an easier and cheaper means than hand-planting, for restoring the scrub' (Macdonald in Ardill 2021:23). In 1922 Macdonald advocated for the utilisation of controlled fire to restore and renew the natural ecosystems of the foreshores; this practice is now referred to as ecological burning.

'Burning-off has this advantage, that it causes a growth not only of tea-tree, the most valuable of the native vegetation thereabout, but also of she-oaks, banksias, coastal wattles, and a few other species native to the locality' (Macdonald in Ardill 2021:27).



**Figure 1. 'Red Bluff, Brighton' 1880-1900. Degraded foreshore reserve with remnant Coast Teatrees Source: State Library Victoria. Author supplied (The photographer is unknown).**

Macdonald also supported the scattering of Coast Teatree seed over prepared, scarified ground, and the replanting of severely degraded areas with local and not introduced species. Unfortunately, Macdonald's ideas on fire were not adopted, possibly due to concerns about fire escape and damage.

The Field Naturalists Club of Victoria and Victorian scientists joined Macdonald's campaign to save the foreshore ecosystems, but their efforts attracted little community and government support. By approximately 1940, much of the indigenous vegetation between Brighton and Mornington had been lost, trampled by picnickers or replaced by amenity facilities such as toilet blocks and parks.

Today, members of the Eastern Kulin nation continue to maintain physical and spiritual associations with Nairn and their traditional homelands. Scattered remnants and intact strips of the east coast vegetation communities persist. As well as the degrading influences already mentioned, these remnants are confronted by new threats: introduced plant species, and climate change. In response, local government entities and community volunteers continue to engage with the restoration and renewal of the foreshore vegetation communities.

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This article was first published on the Australian Ecological Restoration History website at <https://ecologicalrestorationhistory.org/articles/> on 17/02/2021.

# Targeted monitoring and bushfire recovery of the Willi Willi Zieria (*Zieria lasiocaulis*)

DIANNE BROWN<sup>1\*</sup> AND PETER RICHARDS<sup>2</sup>

<sup>1</sup> Department of Planning, Industry and Environment, North East Ecosystems and Threatened Species Team.

<sup>2</sup> Ecological consultant, Sawtell, NSW.

\*Corresponding author: dianne.brown@environment.nsw.gov.au

## Introduction

One of the most significant underlying issues relating to plant conservation and management is the lack of financial resources to achieve confident and successful outcomes. This often means that on-ground management is based on limited information, implied knowledge and surrogates from similar species and habitats. Regardless, modest inputs of resources can provide useful outcomes when targeted and if continued over a long period of time.

The Endangered Willi Willi Zieria (*Zieria lasiocaulis*) (NSW BC Act 2016 and EPBC Act 1999) is an example of a species that has had small but targeted and practical investment over many years. This has mostly been for the establishment and repeated monitoring of plots across the species distributional range. This meant that, when the catastrophic fires of 2019-2020 swept through the area, we were able to measure the impact of the fires on the species, and to document the resulting response.

## Background

The magnificent and rugged Willi Willi National Park, at the headwaters of the Wilson River west of Port Macquarie on the mid north coast, is home to the endemic plant Willi Willi Zieria. This shrub is restricted to approximately 12 km<sup>2</sup> of high elevation moist forest and occurs on rocky escarpments and scree slopes, hilltops, on roadsides, and along margins of Antarctic Beech rainforest (NSW NPWS 2002). It is considered an obligate seeder, with limited resprouting capacity (NSW NPWS 2014). Due to its location in canopy gaps, trail edges and previously burnt areas, it is considered to require disturbance to stimulate germination.

## Willi Willi Zieria monitoring

In 1997, a large population of Willi Willi Zieria was found by botanist Phil Gilmour on the summit of Marowin Mountain, which had been burnt by a fire in 1994, triggering a mass germination event on the mountain top. The population was estimated at between 20,000-25,000 plants (Gilmour 2001).

At this time, seven 5 m x 5 m monitoring plots were established across the species range and in a variety of habitats (Gilmour 2001). An additional plot was added in 2012 (Richards 2014).

Monitoring of these plots was sporadic, due to limited funding. Prior to 2014, only three monitoring events had occurred since establishment. Funding through the NSW Government's Saving Our Species (SoS) program enabled monitoring of Willi Willi Zieria to occur annually. Even with small investments and irregular visits over time, prior to 2019, it was observed that above-ground plant numbers were experiencing a decline as plants grew, matured, and then senesced.

## 2019-2020 bushfire

The 2019-2020 bushfires burnt large areas of Willi Willi National Park (Figure 1), including >65% of Willi Willi Zieria habitat (Auld *et al.* 2020). As soon as it was possible to visit the area after the fires, we undertook two monitoring events; in May 2020 and in August-September 2020, to document the response to fire. Of the eight monitoring plots, five were burnt by this fire. In burnt areas, virtually all Willi Willi Zieria plants were killed, with the exception of a few plants that produced some limited sucker regrowth. Floods in early 2021 have damaged roads and bridges and we have since been unable to access the sites.

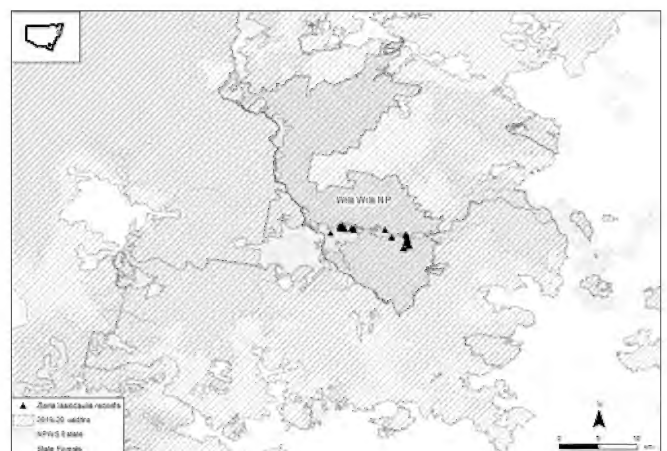


Figure 1. 2019-2020 wildfire extent and Willi Willi Zieria records. Orange shading is Willi Willi National Park.

## Monitoring results

Table 1 shows the results of the plot monitoring for each monitoring event. Prior to 2020, an overall decline in plant numbers was observed. The 2019-2020 wildfire triggered mass germination in burnt areas, particularly in plots 3 and 4 which previously had supported higher plant numbers. These numbers are represented in Figure 2, which indicates that plant numbers across all plots declined to 69 in 2012. Post-fire, this has increased to >1800, although most of these were small seedlings.

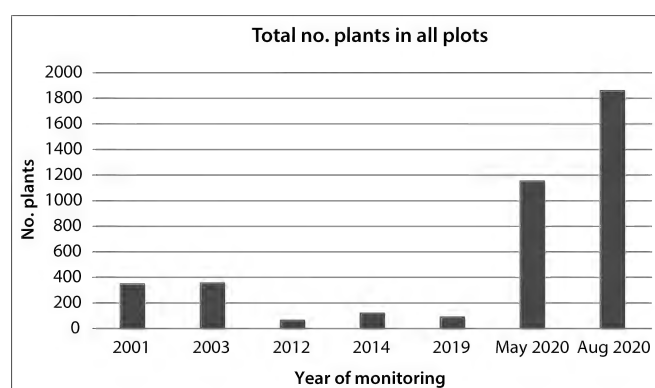


Figure 2. Sum of Willi Willi Zieria plants in all plots for each monitoring year. Note the massive increase in numbers due to germination of seedlings after the 2019-2020 fire.



Figure 3. Counting Willi Willi Zieria seedling germination post-fire in permanent monitoring plots. Plot is marked out in 1m strips to enable more accurate counting of seedlings. Photo Di Brown



Figure 4. Willi Willi Zieria germinants in a burnt area. Photo: Di Brown

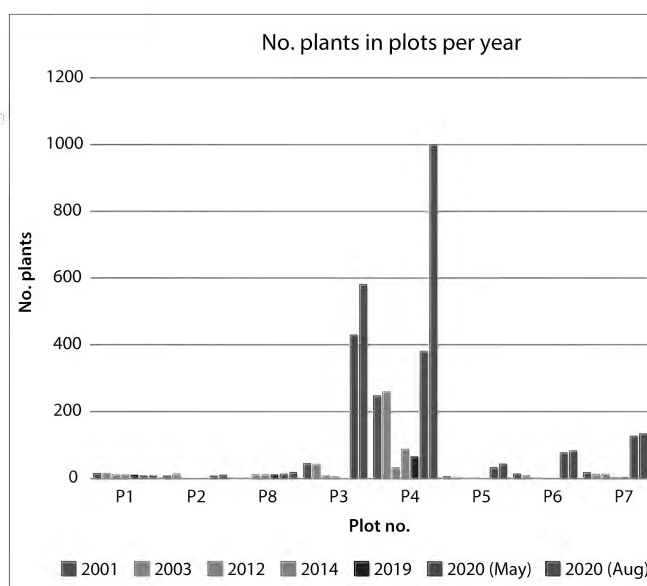


Figure 5. Number of Willi Willi Zieria plants in plots per year of monitoring. Note Plots P1, P2 and P8 were unburnt and P3-P7 were burnt.

Table 1. Number of plants in plots for each year monitored and indicating plots that burnt in 2019-2020 fires.

Plot no.	Year of monitoring							Burnt 2019-2020
	2001	2003	2012	2014	2019	2020 (May)	2020 (Aug)	
1	15	17	11	11	10	8	8	unburnt
2	8	14	1	1	0	8	11	unburnt
3	46	44	9	6	0	431	582	burnt
4	248	260	34	89	66	382	1001	burnt
5	6	4	1	1	1	33	44	burnt
6	14	9	0	1	1	78	84	burnt
7	18	13	13	4	4	128	135	burnt
8	No data	No data	12	12	12	14	19	unburnt



## Discussion

The massive increase in plant numbers following the 2019-2020 bushfires confirms the importance of fire as a trigger for mass germination events. Clearly this points to the need for appropriate fire intervals to maintain populations of Willi Willi Zieria, as short intervals (<10 years) may not allow plants to mature and the seedbank to replenish, whereas too infrequent fire (> 25 years) may result in reduction of plant numbers through senescence and the loss of a viable soil seedbank.

Ongoing monitoring will provide further data on the recruitment and survivorship of Willi Willi Zieria plants. In addition, planned seed longevity trials will assist with determining appropriate disturbance intervals to assist with long-term management of Willi Willi Zieria.

The value of small levels of targeted investment is evident from the results of the Willi Willi Zieria monitoring program. This relatively long-term monitoring study, which has effectively documented the complete life cycle of the target species, has provided a solid knowledge-base from which to target further study and investment. For instance, we are now monitoring sub-plots of seedlings and vegetative resprouts within the original monitoring plots to confirm our estimates of the primary and secondary juvenile periods in Willi Willi Zieria, and to assess mortality over time in this new cohort of plants.

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## Acknowledgments

We would like to thank our many enthusiastic field assistants over the years, including Mel Giese, Phil Gilmour, Keith Kendall, Penny Kendall, Anna Lloyd, Jaime Plaza, Craig Stehn, Brian Tolhurst, Jill Smith, Alex Wyatt and staff from NPWS Macleay Area. Jill Smith helped with map production.



# News from the Australian Seed Bank Partnership

## Bushfire recovery through two years of collaboration

BRADLEY DESMOND

Australian Seed Bank Partnership

Corresponding author: [coordinator@seedpartnership.org.au](mailto:coordinator@seedpartnership.org.au)

In the wake of the devastating 2019–20 bushfires, the Australian Seed Bank Partnership (the Partnership) has worked tirelessly over the past two years to support *ex situ* conservation and recovery across Australia. Our organisation has been fortunate to receive support for six bushfire projects that aim to conserve priority plants within each state and territory. Here we explore these projects, outlining how collaboration has led to nation-wide outcomes.

### Project activities

Our projects include comparable activities that serve to improve our knowledge and ability to conserve native plant species:

- *Seed collections* provide insurance for native taxa against loss from future environmental impacts. Collections ensure the genetic material is represented and secured in long-term *ex situ* conservation seed banks, and provides opportunities for proactive conservation and research. If a species is threatened in later years, actions can be taken to reverse species declines in the wild by utilising collections to bolster populations.
- *Rapid flora surveys* of target areas help to ascertain general vegetation condition, species abundance, population size and impact of pests and diseases. The surveys also provide data on species recovery post-fire, enabling prioritisation of future seed collection work; and provide information to allow appropriate response and management for subsequent events.
- *Germination trials* deliver knowledge of collection viability and unveil the essential process to grow plants from seeds. Each species has specific cues that stimulate them to germinate, such as heat, scarification or chemical treatments. It is therefore critical that following collection, germination protocols are developed and documented for each species to allow stock to be efficiently grown if restoration is required in the future. Propagants from these trials can also be used for translocations, living collections or in seed production areas.

### Completed projects

Three of our completed bushfire projects are described below, with final outcomes summarised in Table 1.

#### 1) Banking on seeds for bushfire recovery Project (BBR):

A grant through the Australian Government's *Wildlife and Habitat Bushfire Recovery Program* supported this project to limit the decline of 27 species from fire affected areas in the ACT, NSW, SA, Vic and WA. As part of the project, the Western Australian Seed Centre, Kensington collected and grew seedlings of *Andersonia echinocephala* and *Banksia solandri* for reintroduction to the Stirling ranges. In April 2021, a helicopter airlifted seedlings into remote exclosures to prevent spreading of dieback (*Phytophthora cinnamomi*).



Figure 1. Seedlings being airlifted into East Bluff Knoll, Stirling Range National Park. Photo: Andrew Crawford.

#### 2) Australian Bushfire Emergency Assessment and Collection Project (ABAC):

We are a long-standing collaborator with the international Millennium Seed Bank Partnership (MSBP). In 2020, the MSBP and the Garfield Weston Foundation provided funding to undertake emergency rapid flora surveys and seed collections. This support allowed partners such as the Tasmanian Seed Conservation Centre to locate and collect seed from previously unbanked montane species from Ben Lomond National Park, including the Wire-head Sedge (*Carex cephalotes*).

**3) Project Phoenix (PF):** Working with Greening Australia, the Partnership delivered various on-ground conservation activities in bushfire affected areas, with a strong focus on the priority flora identified by the Australian Government's Bushfire Expert Panel. One such priority species, the Duck's Head Wasp Orchid (*Chiloglottis anaticeps*), is known from only a few localities in the montane forests of northern NSW. All known population sites were affected by the 2019–20 bushfires, and concern was held for the species. A team from the Australian PlantBank set out in January 2021 to find that the orchids were flourishing. At one location the population was mapped and estimated to be more than 50,000 individuals. This finding enabled conservation collections to be taken, and plans to be made for management actions in following seasons.

### Ongoing projects

**4) Island, Alps, and Forests Project (IFA):** A grant awarded under the Australian Government's Regional Fund, will allow the Partnership to continue our work across seven affected regions in eastern and south-eastern Australia. Our partners will undertake seed collections, rapid flora surveys and germplasm collection activities in association with stakeholders across the regions. For example the Queensland Herbarium worked in conjunction with Quandamooka Traditional Owners to collect an endangered Swamp Daisy (*Olearia hygrophila*) on Stradbroke Island. This was a great opportunity to share knowledge about natural and cultural history, and facilitated the collection of the Island's only known endemic plant.

**5) Emergency Seed Collecting Fund to Save Australian Native Flora (ESF):** Thanks to a very generous offer of support from the UK Department of Foreign and Commonwealth Affairs in February 2020, the Partnership has been able to undertake an emergency collecting program in impacted areas during the first season post-fire. The project is enabling us to make seed collections and deliver germination research for

high priority species such as *Chenopodium erosum*. This Vulnerable Victorian species was previously known from only a few dry and rocky sites at low elevations in the east of the state. Following fires it was observed growing en masse much further west and at higher elevations. This project offered an opportunity to collect from subalpine sites at Mt Buffalo, securing genetic representation of both high and low elevation populations.

**6) The Rare Bloom Project™ (RBP):** This collaboration with WWF-Australia and Botanica by Air Wick aims to improve conservation outcomes for 120 Australian native wildflowers from fire affected and high-conservation-value areas through seed banking, germination research and restoration. Under this project, the South Australian Seed Conservation Centre completed translocation plantings of three species (*Swainsona pyrophila*, *Brachyscome muelleri* and *Coronidium gunnianum*) in the Secret Rocks Nature Reserve and Lobethal Bushland. In August 2021, a total of 470 plants were translocated across four events, with future plantings planned in 2022.

### Future bushfire work

While the Partnership has undertaken significant work to secure species and assess the short-term impact on threatened flora, further effort is needed beyond the immediate post-fire period. In many areas, we have observed positive signs of recruitment and regeneration; however pressures from disease, predation and changing weather patterns mean sensitive species still need careful observation and assistance.

Three of our projects will continue through 2022–23 to protect Australia's native plant diversity through collaborative seed banking, research and knowledge sharing. Working together we will also provide crucial information for management and conservation in the face of future threats.

For more about the Partnership's projects please visit: [seedpartnership.org.au/initiatives/](https://seedpartnership.org.au/initiatives/)

Table 1. Outcomes of ASBP bushfire projects to date.

Project	Seed collections	Rapid Flora Surveys	Germination trials	Propagation
1) BBR	20 (16 taxa)	24 (15 taxa)	18 (8 taxa)	670 (12 taxa)
2) ABAC	9 (9 taxa)	21 (15 taxa)	-	-
3) PF	126 (107 taxa)	192 (90 taxa)	66 (55 taxa)	-
4) IFA	61 (59 taxa)	48 (45 taxa)	-	1320 (14 taxa)
5) ESF	47 (42 taxa)	-	93 (93 taxa)	-
6) RBP	63 (39 taxa)	-	39 (12 taxa)	1320 (4 taxa)

# Australian Academy of Science *Fenner Conference on the Environment* ‘Exceptional Times, Exceptional Plants’

AMELIA J. MARTYN YENSON<sup>1,2\*</sup>, JAYANTHI NADARAJAN<sup>3</sup>, BRYN FUNNEKOTTER<sup>4,5</sup> AND KAREN D. SOMMERVILLE<sup>2</sup>

<sup>1</sup> Australian Network for Plant Conservation

<sup>2</sup> The Australian PlantBank, Australian Institute of Botanical Science, Australian Botanic Garden, Mount Annan NSW 2567, Australia

<sup>3</sup> The New Zealand Institute for Plant and Food Research Limited, Food Industry Science Centre, Fitzherbert Science Centre, Batchelar Road, Palmerston North 4410, New Zealand.

<sup>4</sup> Curtin Medical School, Curtin University, Perth, WA 6102, Australia

<sup>5</sup> Kings Park Science, Department of Biodiversity, Conservation and Attractions, Perth, WA 6005, Australia

\*Corresponding author: amelia.yenson@botanicgardens.nsw.gov.au

## A workshop on identification and conservation of plant species that are difficult to bank using conventional techniques

Sophisticated technologies to preserve plants not suitable for conventional conservation techniques were in the spotlight at the Australian Academy of Science *Fenner Conference on the Environment*. Held during the Australasian Seed Science Conference in September 2021, the virtual event attracted more than 300 scientists, practitioners, students and artists from 29 countries, with about one third already working on these more difficult species. Participants were keen to ask questions, chat with other attendees, respond to poll questions during the sessions, and complete a post-conference evaluation.

The conference focus was on methods to identify and conserve plant species that cannot be conserved using conventional seed banking, which entails drying seeds to 3-7% moisture content and storing them at -20°C. Seed banks are well established to conserve the majority of seed-bearing plant species for future use in restoration, translocation, agriculture and horticulture; 67% of Australia's threatened species, for example, are now represented in conservation seed banks (Figure 1).

Recognition is growing, however, that we need to think beyond seed banks, across Australia and globally, to conserve plant species that don't produce seeds or that produce seeds which don't survive well in conventional storage.

These species are collectively known as 'exceptional species', a term that includes species for which seeds are not available (not produced at all, inadequately produced, or non-viable), species with desiccation sensitive, freezing-sensitive or short-lived seeds, and species with deeply dormant seeds (Case Study 2.5 in the Germplasm Guidelines, Martyn Yenson *et al.* 2021).

Significant advances in identifying and conserving exceptional species *ex situ* have been made in the last decade (e.g., Somerville *et al.* 2021); however, access to resources for methods other than seed banking, as well as difficulty accessing relevant information, remains a challenge for many conservation facilities. In addition, difficulties with germination and propagation can make it hard to assess seed storage behaviour, and to produce plants that can be returned to their habitat *in situ*.

Knowledge sharing is essential for supporting conservation of these species around the globe and has the potential to greatly increase the speed and effectiveness of our conservation efforts. Dr Karen Somerville explains: "Rainforests in the South Pacific, for example, hold thousands of plant species from more than 1500 different genera. Many of those genera are shared across several South Pacific nations, providing a great opportunity for knowledge exchange and collaborative research."

## Identifying exceptional species

Between 5-10% of seed-bearing plant species in the world are not able to be 'banked' using conventional methods and this proportion may be much higher in wetter habitats such as rainforests [48% of 162 Australian rainforest species were recently found to respond poorly to either drying or freezing under standard seed banking conditions; Somerville *et al.* 2021]. While some plant species are readily identified as exceptional by their inability to produce seeds (e.g., ferns and mosses), seed-producing species require a series of experiments comparing germination of fresh seeds to germination of seeds following drying and freezing to determine whether they will survive storage in a seed bank. Species that are tolerant of drying and freezing but likely to be short-lived in storage can be identified by testing germination after artificially aging the seeds at high temperature and humidity.

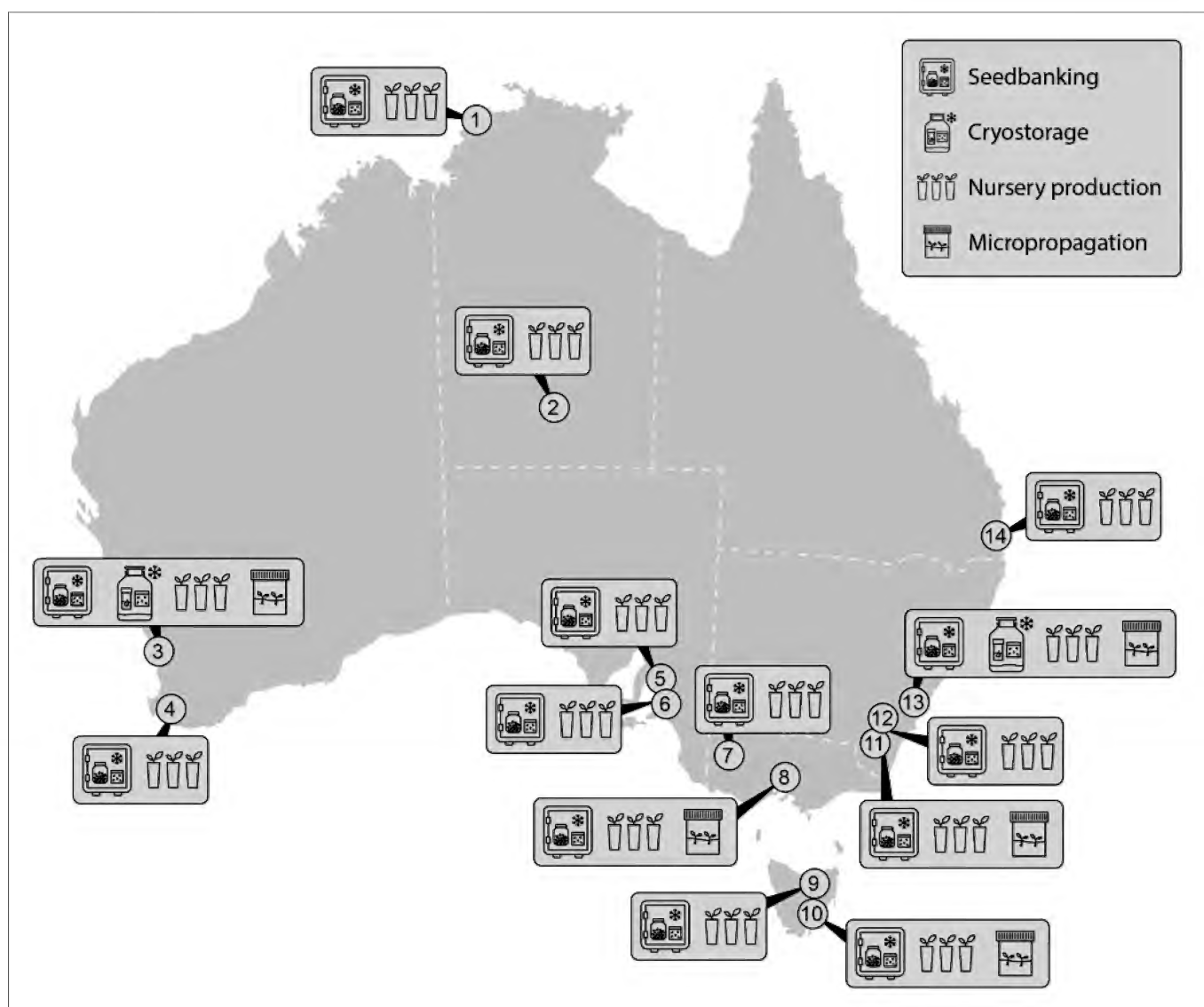


Figure 1. Location of major *ex situ* conservation facilities for Australian flora, including ASBP Partners and Associates\*, the Australian Tree Seed Centre, the Australian Grains Genebank and Australian Pastures Genebank (both storing crop wild relatives) and major forestry seed banks with conservation collections (Image: CAM Graphics; in Offord *et al.* 2021 Germplasm Guidelines Chapter 2).

Key:

1. \*George Brown Darwin Botanic Gardens conservation seed bank
2. \*Alice Springs Desert Park
3. \*Western Australian Seed Centre, Department of Biodiversity, Conservation and Attractions, Kensington, and Kings Park and Botanic Garden
4. Forest Products Commission Seed Centre
5. Australian Pastures Genebank, South Australian Research and Development Institute
6. \*South Australian Seed Conservation Centre, Botanic Gardens and State Herbarium of South Australia (BGSB)
7. \*Australian Grains Genebank, Agriculture Victoria
8. \*Victorian Conservation Seedbank, Royal Botanic Gardens Victoria
9. Tasmanian Seed Centre, Sustainable Timber Tasmania
10. \*Tasmanian Seed Conservation Centre, Royal Tasmanian Botanical Gardens
11. \*National Seed Bank, Australian National Botanic Gardens
12. Australian Tree Seed Centre, CSIRO
13. \*Australian PlantBank, Australian Institute of Botanical Science, Royal Botanic Gardens and Domain Trust
14. \*Brisbane Botanic Gardens Conservation Seed Bank, Brisbane Botanic Gardens, Mt Coot-tha



These processes are made considerably more difficult when seeds are hard to collect in good quantities, hard to germinate or take a very long time to complete germination. These issues were highlighted in a conference survey in which about half of all participants indicated they found it challenging to identify which species are exceptional. The first session of the Fenner Conference therefore focused on techniques for identifying exceptional species, and included a presentation on a recently published key that can be utilised to determine the likely response of a species to desiccation without germination testing (Sommerville *et al.* 2021; Chapter 6 Germplasm Guidelines). This session also included the first screening of a video, prepared by the ANPC, demonstrating how to use the key (<https://youtu.be/Eb-eUFMB5p0>).

### Cryopreservation as a long-term conservation tool for exceptional species

Cryopreservation is one option for preserving exceptional species and involves the storage of samples at ultra-low temperatures, typically in liquid nitrogen ( $-196^{\circ}\text{C}$ ). These low temperatures preserve the tissue, as many of the cellular processes are halted as the samples vitrify, until the samples are rewarmed as needed in the future. Samples have been cryopreserved for over 40 years with little loss in viability (Pence *et al.* 2017). A wide range of germplasm can be cryopreserved, making it a valuable long-term conservation tool for exceptional species; seed, embryo axes, *in vitro* cultured shoot tips, dormant buds, fern spores and pollen have all been successfully cryopreserved (Chapter 10 Germplasm Guidelines, Martyn Yenson *et al.* 2021). The second session of the Fenner Conference focused on how cryopreservation can be applied to a range of germplasm from exceptional species, primarily in Australia and New Zealand (Figure 2).

### Cryopreservation of exceptional species in New Zealand

New Zealand is home to approximately 2500 native species of which more than 80% are endemic. The latest New Zealand Threat Classification System listing identified 403 species as threatened with 213 nationally critical; 77 nationally endangered; and 113 nationally vulnerable (de Lange *et al.* 2018). Natural disasters (fire, flood, hurricane and earthquake), climate change, land use for development and agriculture and disease have been the major threats for New Zealand's flora. For example, the incursion of Myrtle Rust (*Austropuccinia psidii*), in New Zealand in May 2017, has resulted in all native New Zealand Myrtaceae species being listed as threatened (Nadarajan *et al.* 2021). *Ex situ* conservation strategies to complement *in situ* conservation programmes are deemed critical for conservation of these threatened species. However, many of New Zealand's endemic species have received little attention in terms of long-term conservation.

Development of cryopreservation protocols for embryos and embryonic axes can be straightforward in some species. Nevertheless, for many species, this requires the understanding of fundamental cryobiology and the incorporation of cryobiotechnology knowledge to elucidate and overcome some of the challenges associated with low or no survival following cryopreservation.

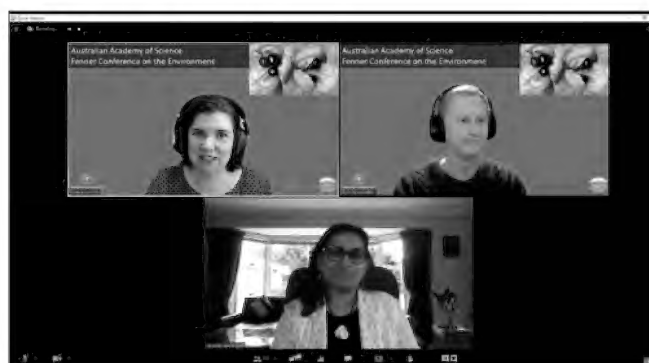


Figure 2. Facilitator and Germplasm Guidelines project manager Dr Amelia Martyn Yenson in discussion with Dr Bryn Funnekotter and Dr Jayanthi Nadarajan during session 2. Image: Lucy Commander

### Using all the tools of *ex situ* conservation to conserve our national plant treasures

Conservation of a genetically representative collection of threatened and common species requires a range of *ex situ* techniques – such as cryobiotechnology, micropropagation (tissue culture) or ‘extreme horticulture’ – to conserve them under expert care away from their natural habitat. The need for a range of complementary *ex situ* techniques was the focus of the panel session at the conclusion of the conference (Figure 3).

Identifying the technologies required to store these exceptional Australian plants requires collaborative research partnerships and sophisticated management of plant collections. But to address these issues with the urgency required in the current environmental crisis, long term funding and cohesive research partnerships must be established.

A good example of this type of work is a 5-year project to preserve plants endemic to tropical mountain tops that are highly threatened by climate change. The project utilises a combination of horticulture, seed banking and seed research to develop *ex situ* collections preserving multiple species at multiple locations. The rescue mission is a collaboration among the Australian Tropical Herbarium, the Australian National Botanic Gardens, Western Yalanji Traditional Owners, the Wet Tropics Management Authority, the Royal Botanic Gardens and Domain Trust, the Royal Botanic Gardens Victoria, and the Dandenong Ranges, Brisbane, Cairns and Mossman Botanic Gardens. See also <https://www.jcu.edu.au/news/releases/2019/april/mountain-rescue>.

These partnerships are critical to the delivery of the Australian Government's new Threatened Species Strategy. Threatened Species Commissioner Dr Fiona Fraser noted: "Under the Australian Government's first Threatened Species Strategy, our collaborative efforts increased the representation of threatened flora in seed banks. As our changing climate continues to impact biodiversity, the *ex situ* preservation of plant species has never been more vital. We will build on these important efforts in the new Threatened Species Strategy and Action Plan."

A significant outcome of the conference was recognition that both formal guidelines such as the Germplasm Guidelines, and peer-reviewed journal papers, are essential information sources for conservation of exceptional species. Databases, such as those maintained by the Australian Seed Bank Partnership (<https://www.seedpartnership.org.au/initiatives/australian-seed-bank-online/>) and Kew's Seed Information Database (<https://data.kew.org/sid/>), are also key to sharing information.

Webinars planned for the final six months of the Germplasm Guidelines revision project, funded by the Ian Potter Foundation, will assist practitioners and scientists throughout the region to consolidate local, regional and personal contacts to support their work in this "critical window of opportunity" before extinction may occur (Sommerville *et al.* 2018). Australian conservation leaders must share their expertise with others in less well-resourced countries to stem global biodiversity losses.



**Figure 3.** In session 3, Dr Cathy Offord facilitated a panel discussion with Dr Linda Broadhurst, Mr Damian Wrigley (top), Dr Lydia Guja, Dr Nathan Emery, Ms Karin van der Walt (centre) and Dr Karen Sommerville and Mr Gibson Sosanika (bottom). Image: Lucy Commander

Recordings of the Fenner Conference are available on the ANPC's YouTube channel: <https://www.youtube.com/c/AnpcAsnAu>

For more information on webinars and resources relating to the Fenner Conference, subscribe to ANPC's free e-newsletter: <https://www.anpc.asn.au/anpc-news/>

Thanks to the Australian Academy of Science Fenner Conference on the Environment (<https://www.science.org.au/fenner-conferences-environment>) for supporting this event.



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Editor's note: Kew's Seed Information Database will be taken down on 1 May 2022. There are plans for the information to be made available elsewhere, see: <https://seedscisoc.org/important-notice-regarding-the-seed-information-database/>

# ANPC member profile

## Dr Steve Douglas

### What is your current position?

Principal of Ecological Surveys & Planning consultancy

### What projects are you working on now?

I'm completing a second round of the Commonwealth-funded, NSW-administered Priority Plants research, having visited many sites to obtain basic information about species' response to fire, other threats, plus several unburnt 'control' sites. In most instances, responses are positive and there is little or no reason for concern about that species post-fire, but in one case, weed invasion is a severe threat to an ultra-endemic species that looks likely to be listed as threatened. In another, the current situation indicates a dramatic decline in population size for a species that would ordinarily be expected to do well post-fire. Hopefully, there is more seed bank that will generate in the next year or two, but at present, the number of seedlings is much lower than the apparent number of pre-fire adults.

I'm also working on what amounts to the same work but funded through the NSW Environment Trust for my local Council. It has also shown some mixed results, but mostly positive, with some populations having increased post-fire, at least during the flush of seedling growth.

I have a couple of subcontractors assisting me to review 355 plants on the NSW Significant And Irreversible Impact (SAIL) list. We are assessing some parameters that determine whether and why they should stay on that list or be removed, specifically extent of occurrence (EOO), area of occupancy (AOO), and number of 'locations' in the IUCN sense.

### How did you end up working in plant conservation?

I have had an interest in native plant conservation in some form since my teens. I remember knowing plant names that the high school teacher didn't during a geography fieldtrip to Cumberland State Forest. I would have learnt these from my mother, who trained as a horticulturalist and then as a bush regenerator, and who still works with me occasionally. I was very involved as a volunteer with the NSW National Parks and Wildlife Service (NPWS) and undertook fieldwork and reporting to document the merits of various proposed additions to NPWS estate. That was a very useful experience. My first jobs out of undergrad university were in catchment management, and during that time, I wrote a Masters dissertation about the significant flora of part of northwestern Sydney. It was seen by a NPWS



Documenting the flora of a new private conservation agreement over a property in the Southern Highlands of NSW.  
Photo: Janelle Menzies

employee, and I was recruited to work on the Urban Bushland Biodiversity Survey of Western Sydney with the late Teresa James and Anders Bofeldt. When that role ended, I went into consultancy, and was given surplus jobs by a more experienced colleague. I was later able to reciprocate. I've remained self-employed except for when I had a PhD scholarship and when I took on a labour-hire staff role for the then Office of Environment and Heritage in vegetation mapping.

### What is your favourite plant and why?

There are too many to choose from. Eucalypts, Persoonias, Darwinias, Callistemons, Styphelias, and more recently, Asteraceae such as *Olearia* and even *Brachyscome* (not because I appreciate the taxonomy). It's more a case of which species needs my attention at a particular time, such as when there appears to be a new taxon that needs describing and/or something that is very threatened and needs legal recognition as such, or its conservation and legal status upgrading.

### Why do you think the ANPC network is important and what do you see as our priorities?

Good-news stories are important given there are plenty of reasons to be concerned about the state of Nature. Sharing useful information and seeing what others are doing is helpful and can prevent duplicated effort. It is all too easy for people to be working on the same thing or very closely related issues, and not know about each other's work.

Cute and furry animals or charismatic megafauna get so much of the economic and political attention, whereas plants often struggle to compete in those regards, unless they have spectacular flowers and are easy to grow.

I'd like to see the ANPC take on more of a lobbying role, as well as enhancing its function as a hub for sharing information about research and findings. I see a need to convince governments of the need to dramatically improve the resourcing of their Threatened Species Scientific Committees or equivalent bodies. These entities probably need to become more like substantive staff roles, rather than being based on members who are drawn from a range of existing roles and must do the Committee work on top of that, with relatively infrequent

meetings. These bodies have a huge backlog of work just to ensure that all species and ecological communities have current and properly defined conservation assessments, let alone the large body of work to catch up with changes in threat status after the 2019–20 drought, fire, flood tryptic. Having prepared many nominations to list threatened flora species and communities, mostly in NSW, I've seen the time that it takes these Committees to process nominations blow out dramatically. In NSW, that Committee now seems to take as many as 4 years to process relatively basic flora species nominations to the point where they are exhibited for public comment. This is dangerously unsound and seems to indicate a lack of commitment from government to properly constructing and resourcing a key decision-making body.

## Book Reviews

### Presenting Science Concisely

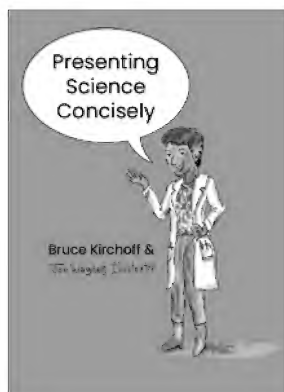
Bruce Kirchoff and Jon Wagner, Illustrator. Paperback. Published November 2021. \$44.99 ISBN: 9781486314683. 134 pages. CSIRO Publishing.

Bruce Kirchoff's newly released book 'Presenting Science Concisely' explores sharing science through stories. This book promises readers they will become better communicators and improve their papers, grants and talks. Each chapter focuses on a story telling structure or communication form including posters, elevator pitches and even how to introduce yourself at a networking event.

This book draws a parallel between stories and science, suggesting learning to tell better stories will make you a better communicator. It attempts to convince readers that the scientific process fits the narrative structure used in movies and plays. Kirchoff believes you can follow the narrative structure to frame the scientific process as a simple story which will hold an audience's attention and allow you to express your personal attachment to the work.

Science students or those early in their research career may like to skim this book. Each chapter is concise, focusing on one main idea or communication method. It provides full colour examples and QR codes which link to further examples or tutorial videos. Most chapters also contain exercises so you can test what you've learnt (if you have that much spare time!). Jon Wagner's colourful cartoons are a visual treat, scattered throughout the book to break up the text heavy format.

While great for beginners, this book lacks the level of detail necessary for more advanced readers. It also fails to touch on communicating with intermediaries such as journalists or science communicators. Instead of suggesting researchers develop relationships with these people the book states



"the media misrepresents the nature of science" framing media organisations as the enemy which is only focused on the results of science rather than the process.

Regardless of your opinion on this, learning how to share research through non-traditional methods should be a consideration. If you're looking for tips on sharing science using social media or how to prepare a media release this book will disappoint you. Instead, it focuses on using the narrative structure to share your research through traditional communication

methods such as posters and seminars.

There is also a lack of depth in the chapter on audiences – the main consideration in all communication. Chapter 8 'It is all about the audience' is brief, teaching readers they must flatter or avoid berating particular audience members. It would be more useful to include practical tips on how to alter your communication style for different audiences. Maybe readers should expect this as the introduction clearly states "this book is not primarily about techniques. It is about expanding your potential as a human being". If your potential needs to expand to create a poster or introduce yourself then this is the book for you. Those wishing to grow their science communication skills by learning specific techniques will need to look elsewhere.

Overall, this book is a great jumping off point for students and new researchers who want quick instructions on how to complete a task, particularly posters and Three Minute Thesis competition entries.

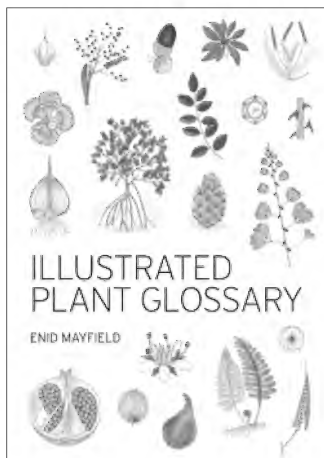
*Review by Christine Fernance*

# Illustrated Plant Glossary

Enid Mayfield, 2021. CSIRO Publishing, Clayton South. 332 pp. ISBN: 9781486303533. RRP \$69.99

Botany is a discipline with its own language covering a vast array of specific descriptive terms. Anyone who works with, studies or has a keen interest in plants will inevitably come across terms that they are unfamiliar with. Glossaries have been around for many years and aid those interested in learning about plants to come to grips with botanical terminology. They vary from text-only to those that include text and some (typically black and white) line illustrations or photographs. While most are in book form, some are available online. Enid Mayfield's quest to produce a superior botanical lexicon has taken seven years of dedication. The result, the *Illustrated Plant Glossary*, is a reference that Enid wanted to be 'exceptional, excellent and the very best available- exemplary even'.

The hard copy version of the book is A4 size and available in soft cover only. The actual glossary comprises almost the entire book with only a very brief preamble including foreword, acknowledgements, about the author and introduction. The glossary has a predominantly two-column format, and the layout is spacious and uncluttered. More than 4000 terms related to plant sciences are included, these being arranged alphabetically, many with an accompanying illustration. The glossary covers terms from a range of botanical themes including morphology, anatomy, physiology, chemistry, classification and major taxonomic groups, nomenclature, cytology, genetics, evolution, palynology, reproduction, habitat and ecology, and modern systematics. Morphological terms are comprehensively covered for flowering plants and ferns, and these make up a significant proportion of the terms included in the glossary. By way of comparison the *Illustrated Plant Glossary* includes virtually all terms covered in the glossaries associated with the Floras of NSW and Victoria, and a reasonable number of additional terms. Glossaries can never include absolutely all terms in use – the compiler must draw the line somewhere. In Mayfield's glossary, some terms relating to taxonomic groups, such as eucalypt bark-types or specific bryophyte terminology are not included, and the user must consult specialist treatments on those subjects. Although the range of terms included for non-morphological themes is less comprehensive, common and important terms are included enabling the reader to grasp a basic understanding. Due to the sheer number of references consulted the author chose to exclude them but I think the inclusion of a list of primary references would have been useful.



Botanical terms are defined in a concise, well-crafted manner with extensive cross referencing (*i.e.*, using '=', 'see', 'see also' and 'cf.'). In the case of '=', all equivalent terms (*e.g.*, hypanthium and floral tube) are included with the same, or virtually the same text and illustration/s (if present). Typo errors, over-simplified definitions or inconsistencies are rare and minor (*e.g.*, the terms monopodial and sympodial lack a cross-referencing 'cf.', and the definition of forest overlooks crown spacing *cf.* woodland). Where appropriate, exemplary taxa (mainly Australian native species and common introduced garden

plants) are noted or illustrated, which helps to strengthen the clarity of the definition.

The illustrations are mostly diagrammatic and are positioned adjacent to the text defining each term. The watercolour rendered line illustrations are clear, accurate, and quite beautiful with their appealing soft pastel colours on semi-gloss paper. Where appropriate, colour has been used effectively to highlight a certain feature, as in the illustrations of stipule types. Labelling of specific features in an illustration is unobtrusive and generally adequate. With few exceptions the illustrations are well reproduced. More detailed illustrations (and definitions) of indumentum types could be considered for a second edition, so that the various terms (*e.g.*, pubescent) are more easily discriminated. The glossary includes a few particularly useful full-page plates, including those comparing different inflorescence and fruit types, and leaf features. The later includes familiar illustrations of leaf shape, bases, lobing, margins *etc.*, but also less commonly seen illustrations of leaf venation types.

In summary, I highly recommend this aesthetically pleasing glossary and commend the author on her achievements. Its strength lies in the extensive list of terms included, which are both beautifully illustrated in colour and defined in a way that is easily comprehended. The glossary is also available in e-book file format as ePDF and ePUB.

*Review by David Albrecht, Australian National Herbarium, Centre for Australian National Biodiversity Research, (a joint venture between Parks Australia and CSIRO), GPO Box 1700, Canberra ACT 2601 dave.albrecht@csiro.au*



# News and conferences

## ANPC News

### ANPC in THE BOTANIC GARDENER

An article on the three different guidelines the ANPC has recently updated has been published in BGANZ's magazine THE BOTANIC GARDENER. This article explains what is in the different guidelines, when to use them and how to find them. You can download the summer edition of the magazine here

[https://issuu.com/bganz/docs/tbg\\_iss57\\_dec2021\\_final\\_211129/30](https://issuu.com/bganz/docs/tbg_iss57_dec2021_final_211129/30).

### 'Plants Going Places' Translocation Workshop

Due to the ongoing uncertainty surrounding face-to-face events, the three threatened plant workshops originally planned to be held in Melbourne, Ballarat and Bairnsdale this year are now going to be held as one online event. Chantelle Doyle, who produced the three Plants Going Places videos for the ANPC, will be coordinating and facilitating the workshop and we would like to welcome her to the team. Chantelle is currently completing a PhD focused on practitioner experiences of threatened plant translocation and produces the accompanying website ([plant-heroes.com](http://plant-heroes.com)) which shares some of those practitioner stories. Chantelle has also planned and undertaken translocations of the Sydney Basin endemic, Julian's Hibbertia (*Hibbertia spanantha*).

We will be sharing more details on the workshop shortly so keep an eye on our newsletter and social media channels for more information.

If you have translocation experience to share and would like to contribute to the workshop please email Chantelle at [translocation@anpc.asn.au](mailto:translocation@anpc.asn.au)

<https://www.anpc.asn.au/plants-going-places/>

### Conference Update

Over 3-7 April 2022 the ANPC held the 13th Australasian Plant Conservation Conference' in Albury and online. We will be making recordings available to delegates shortly.

<https://www.anpc.asn.au/conferences/apcc13/>

### Plant Treasures – in conversation

Over the first half of 2022 the ANPC is presenting a webinar series based on the updated 3rd edition of the Germplasm Guidelines, funded by The Ian Potter Foundation.

These webinars are a collaborative project with the BGANZ BCARM Plant Forum. Titled 'Plant Treasures – in conversation' this series offers the opportunity for networking with colleagues while listening to your peers present on a Germplasm related topic.

The first webinar 'Plant Treasures – in conversation about data collection and record keeping in ex situ collections' was held on Thursday 10 February. Our speakers includes Emma Bodley, Botanical Records and Conservation Officer from the Auckland Botanic Gardens and Damian Wrigley, National Coordinator of the Australian Seed Bank Partnership, along with Amelia Martyn Yenson, ANPC Project Manager for the Germplasm Guidelines revision.

The 2nd webinar was held on Thursday 10 March and discussed biosecurity in conservation collections. Some special guests kick started the conversation, including Dr Brett Summerell from the Australian Institute of Botanical Science, Bob Makinson, Conservation Botanist and former ANPC president and Bec Stanley of Auckland Council and former curator of the Auckland Botanic Gardens.

The next webinar in the series is scheduled for Thursday 12 May 2022 from 10:30am to 1:30pm AEST. Over three hours you will find out all about 'The role of the nursery and living collections in conserving native plant species' with a focus on current practice and future needs. Amelia Martyn Yenson has put together an amazing line up of 12 presenters giving live talks, with plenty of time to ask questions and join the panel discussion. We'll also be sharing new videos during the webinar, featuring experienced presenters talking about ex situ collections and demonstrating collection techniques.

Head to the Germplasm playlist on the ANPC YouTube channel for all webinar recordings.

<https://www.youtube.com/playlist?list=PLuPMH5OJZz0H4sZRy3vJ9nussmfStAlon>

### Now available – hard copies of the Germplasm Guidelines

Hard copies of the third edition of *Plant Germplasm Conservation in Australia* are now available to purchase from the ANPC website. This evidence-based best practice guide is the most up to date resource for the management of *ex situ* (off site) collections of seeds, plant tissues, or plants in nurseries and living collections. Thanks to the generous funding for this project from The Ian Potter Foundation we are able to offer our ANPC members the guidelines at a very reasonable \$25 (including postage within Australia). The revised edition contains 550 pages of case studies and evidence-based information. Head to the publications page to secure your copy of this fantastic resource now. <https://www.anpc.asn.au/product/plant-germplasm-conservation-in-australia-3rd-edn-print-version/>

## ANPC's highlights from 2021

### OUTREACH

Our events:

- An international Orchid Conservation Symposium
- The '4 seasons of seed' workshop series
- Helped convene a national Myrtle Rust Symposium
- Hosted the Australian Academy of Science Fenner Conference on the Environment 'Exceptional Times, Exceptional Plants'



Produced the Plant Treasures videos series and a translocation video and podcast series



Project Managers presented at 6 conferences and online forums



Produced a fact sheet series and communications products for the Australian Seed Bank Partnership

### PUBLICATIONS



### CONTRIBUTIONS



Assessed the impact of 2019/20 fires on threatened plants in QLD and NSW

- Provided input to the First Nations led "Right Plant, Right Way" Victorian Revegetation Review

- Joined the consortium supporting the UN Decade on Ecosystem Restoration



Propagated and reintroduced 50 Audas Spider Orchids and 400 Brilliant Sun Orchids

- Hosting the Australian Plant Translocation Database on our website

- Networking role in stage 2 of the Bring Back the Banksias project

# Plant Cuttings

Editors' note: News excerpts are clipped from a diversity of sources. To read the articles in full follow the links attached to each clipping. The views expressed in these articles are those of their authors and do not necessarily represent the opinion of the ANPC.

## **Prioritizing where to restore Earth's ecosystems – Simon Ferrier, *Nature* 14 October 2020**

Targets for ecosystem restoration are usually specified in terms of the total area to be restored. A global analysis reveals that the benefits and costs of achieving such targets depend greatly on where this restoration occurs. <https://www.nature.com/articles/d41586-020-02750-2>

## **To save threatened plants and animals, restore habitat on farms, ranches and other working lands – *The Conversation*, 29 October 2020**

Restoring native habitats to at least 20% of the world's land currently being used by humans for farming, ranching and forestry is necessary to protect biodiversity and slow species loss, according to a newly published study conducted by a team of environmental scientists including us. Our analysis found that this can be done in ways that minimize trade-offs and could even make farms more productive by helping to control pests, enhancing crop pollination and preventing losses of nutrients and water from soil. <https://theconversation.com/to-save-threatened-plants-and-animals-restore-habitat-on-farms-ranches-and-other-working-lands-148523>

## **Supporting Indigenous Research – media release by Minister for Education Dan Tehan, 3 November 2020**

The Morrison Government is funding university research to improve the lives of Indigenous Australians while providing leadership and training opportunities to Indigenous researchers. Minister for Education Dan Tehan announced \$7.1 million for nine new research projects through the Australian Research Council (ARC) *Discovery Indigenous* scheme. <https://www.arc.gov.au/news-publications/media/media-releases/supporting-indigenous-research>

## **Citizen Orchid – Gardening Australia film clip, 6 November 2020**

Orchids are one of the largest plant families on earth with thousands of species, and Australia has some of the rarest ones. Sophie meets orchid expert's Dr Robert and Rosalie Lawrence for a careful walk to find some orchids in remnant bushland outside of Adelaide. <https://www.abc.net.au/gardening/citizen-orchid/12848698>

## **Monitoring ecosystems after intense fires – *The Science Show*, 7 November 2020**

The fires in eastern Australia over the summer of 2019 and 2020 were widespread and severe. So how have ecosystems been affected? Peter Hadfield joined ecologists and locals with knowledge of flora and fauna inspecting forests recently burnt by fire. As ecologist Chris Dickman explains, while Australian species are adapted to fire, the intensity of recent fires will likely lead to permanent changes in ecosystems and could even lead to collapse with eucalypt forests replaced by other ecosystem types. <https://www.abc.net.au/radionational/programs/scienceshow/monitoring-ecosystems-after-intense-fires/12855816>

## **Australian researchers find native grasses could be grown for mass consumption – Lorena Allam, *The Guardian*, 10 November 2020**

Native grasses could be grown for mass consumption, a one-year feasibility study has found, after researchers tested 15 different species "from paddock to plate" in north-west New South Wales. <https://www.theguardian.com/australia-news/2020/nov/10/australian-researchers-find-native-grasses-could-be-grown-for-human-consumption>

**Captain Cook used a native Australian plant to fight scurvy. Are Indigenous foods the future? – Emma Rennie, ABC, 12 November 2020**

Juru and Kanaka man Gerald Power often hears from people that food eaten by First Nations people in the tens of thousands of years before colonisation did not have much seasoning. It is a myth he is keen to correct. Mr Power cultivates many edible native plants, including bush basil, curry myrtle and river mint, in a community garden in Orange, in central-western NSW.

<https://www.abc.net.au/news/2020-11-12/australian-food-indigenous-herbs-school-cooking-programs/12860554>

**Tree collecting is becoming a conservation mission with plenty eager to sign up – Megan Backhouse, The Sydney Morning Herald, 13 November 2020**

Of all the things you might amass, trees would have to be one of the most unwieldy. They take up space and they soak up time. It's not a pursuit for the restless.

<https://www.smh.com.au/lifestyle/health-and-wellness/tree-collecting-is-becoming-a-conservation-mission-with-plenty-eager-to-sign-up-20201106-p56c62.html>

**Future Forests – Gardening Australia film clip, 20 November 2020**

In this snippet from episode 36 (series 31) of Gardening Australia Josh explores how an Urban Forest Strategy developed by community volunteers is successfully bringing nature into the city. If you look closely you will catch Florabank project manager Dr Lucy Commander planting seedlings in the background.

[https://www.abc.net.au/gardening/factsheets/future-forests/12904494?fbclid=IwAR1pMzpl-GKR\\_76d6UCpBPZZhjBPJ0hrEbTK2JD4zZA-qonpISYts3H5Tfc](https://www.abc.net.au/gardening/factsheets/future-forests/12904494?fbclid=IwAR1pMzpl-GKR_76d6UCpBPZZhjBPJ0hrEbTK2JD4zZA-qonpISYts3H5Tfc)

**'The power of the earth': Bruce Pascoe on grass and fire – Miki Perkins, The Sydney Morning Herald, 20 November 2020**

The name for this grass in the Yuin language is mandadyan nalluk – "dancing grass" – and it is almost ready for harvest on this 56-hectare property owned by Bruce Pascoe, the author of the award-winning *Dark Emu*.

<https://www.smh.com.au/national/victoria/the-power-of-the-earth-bruce-pascoe-on-grass-and-fire-20201119-p56fxx.html>

**Denmark locals mourn loss of decades-old fig tree bulldozed by developer on WA's south coast – Toby Hussey, ABC, 21 November 2020**

Members of a small town on Western Australia's south coast are mourning the felling of a tree they say had been a part of their community for generations. Residents in Denmark, a town of fewer than 3,000 in the Great Southern region, are said to have been shocked after the developer LWP demolished, without warning, an allegedly decades-old fig tree on the site of a former historic tourist area.

<https://www.abc.net.au/news/2020-11-19/frustration-over-fairy-world-fig-tree-loss-in-denmark/12899600#:~:text=Residents%20in%20Denmark%2C%20a%20town,a%20former%20historic%20tourist%20area..>

**Milton farmers help conserve rare subtropical rainforest on New South Wales south coast – Ainslie Drewitt Smith, ABC, 22 November 2020**

Thousands of trees are being planted at Milton on the New South Wales south coast in a bid to expand and conserve a rare patch of subtropical rainforest. H:\ANPC\Website\Thousands of trees are being planted at Milton on the New South Wales south coast in a bid to expand and conserve a rare patch of subtropical rainforest.

**Argyle diamond mine's traditional owners turn to native seeds in bid to restore country – Courtney Fowler, ABC, 23 November 2020**

The closure and rehabilitation of Australia's most famous diamond mine is being seen as an opportunity for traditional owners to reconnect with country and grow an exciting new business venture in the remote East Kimberley.

<https://www.abc.net.au/news/rural/2020-11-21/argyle-mine-transitioning-from-pink-diamonds-to-native-seed/12902012?fbclid=IwAR1kEsn6hWf6Qem p7W6tWGV9ZqCjytFXziTOdyN4fbGqeYqMK1MZy2tO pmk>

**Worrying about weeds: Australia's invasive species – The Conversation Hour, 24 November 2021**

From cacti in Maldon to gorse in South West Victoria, weeds are clogging waterways, increasing fuel loads for bushfires and causing havoc for farmers.

So what happens if weeds continue to run roudge? A CSIRO report says actions taken now will determine how much weeds control our land in the future.

<https://www.abc.net.au/radio/melbourne/programs/theconversationhour/the-conversation-hour/13636018>

### **The disappearing forests – ABC News, 30 November 2021**

Central to Ian Moore's work is sustainability and Victorian ash is pitched as "the most environmentally friendly building product available".

"When I first looked at it, you know, you read the material about sustainable logging... I would have said that it was a very good choice from a sustainable point of view," says Mr Moore.

[https://www.abc.net.au/news/2021-11-30/vicforests-accused-of-failing-to-regenerate-logged-forests/100652148?utm\\_source=Environment+Victoria&utm\\_campaign=feab6320aa-EMAIL\\_CAMPAIGN\\_2021\\_11\\_26\\_02\\_32&utm\\_medium=email&utm\\_term=0\\_c6b62620d2-feab6320aa-297428598&mc\\_cid=feab6320aa&mc\\_eid=2d3989345e](https://www.abc.net.au/news/2021-11-30/vicforests-accused-of-failing-to-regenerate-logged-forests/100652148?utm_source=Environment+Victoria&utm_campaign=feab6320aa-EMAIL_CAMPAIGN_2021_11_26_02_32&utm_medium=email&utm_term=0_c6b62620d2-feab6320aa-297428598&mc_cid=feab6320aa&mc_eid=2d3989345e)

### **Biologist Merlin Sheldrake says without fungi, 'there would be no land plants' – ABC Radio National, 1 December 2021**

Merlin Sheldrake describes fungi as something strange and peculiar. But it's also fascinating, which is why the study of some of the world's tiniest and largest organisms has consumed his life for almost three decades.

<https://www.abc.net.au/news/2021-12-01/merlin-sheldrake-entangled-life-fungi/100649456>

### **Victoria's once-common plants and animals in serious decline – The Sydney Morning Herald, 2 December 2021**

Victoria's native animals and natural landscapes are in a state of serious decline, as population growth and land clearing put ecosystems under pressure and climate change causes more extreme natural disasters such as bushfires. A wide-ranging state government inquiry into the state of health of Victoria's environment has found clearing of native vegetation and the creep of invasive species are threatening the state's biodiversity.

<https://www.smh.com.au/environment/conservation/victoria-s-once-common-plants-and-animals-in-serious-decline-20211202-p59e3l.html>

### **AUDIO: 124 animals and plants added to the threatened species "red list" – ABC News Radio, 10 December 2021**

The "red list" published by International Union for the Conservation of Nature, has been updated with over 120 new entries for Australian wildlife.

<https://www.abc.net.au/news/2021-12-10/124-animals-and-plants-added-to-the-threatened/13671304>

### **Trees get sunburnt too – but there are easy ways to protect them, from tree 'sunscreens' to hydration – The Conversation, 15 December 2021**

We all know how hot and damaging the summer sun can be in Australia and most of us are only too willing to take sensible precautions, and slop on sunscreen. But have you ever wondered about sun damage to plants? Can trees be sunburnt? It may surprise you to know the answer is actually yes!

<https://theconversation.com/trees-get-sunburnt-too-but-there-are-easy-ways-to-protect-them-from-tree-sunscreens-to-hydration-172953>

### **Three million hectares of WA land to be released for carbon farming – The Sydney Morning Herald, 15 December 2021**

The WA government will make 3 million hectares of land available for carbon farming to create Indigenous jobs in remote areas, rehabilitate abandoned pastoral leases and create offsets for industries that cannot reduce their emissions.

<https://www.smh.com.au/environment/sustainability/three-million-hectares-of-wa-land-to-be-released-for-carbon-farming-20211214-p59hkv.html>

### **Bladderworts suck in animals and eat them alive. But which species are meeting this grisly demise? – ABC Esperance, 5 December 2021**

Although the hunting tactics sound messy, they are in fact so covert that no one has managed to identify exactly what species of animals the plants are ingesting. Mr Krueger, a PhD student at Curtin University, hopes to change that.

<https://www.abc.net.au/news/2021-12-05/bladderworts-carnivorous-plant-meat-eating-diet-wa-esperance/100669608>



**Native species seed bank brings rare plants back from the brink of extinction – ABC Eyre Peninsula, 20 December 2021**

A project to help recover some of South Australia's rare flowering plants is blooming on Eyre Peninsula, thanks to a seed bank that aims to ensure more than 80 per cent of the state's most-threatened species survive into the future.

<https://www.abc.net.au/news/2021-12-20/native-plant-seed-bank-saves-flowering-species-from-extinction/100710226>

**Secret crop of near-extinct Oaklands donkey orchids discovered in the Riverina – ABC News, 21 December 2021**

Rangers have discovered a secret meadow of near-extinct native orchids on a travelling stock reserve in the Riverina. The extremely rare Oaklands donkey orchid comes from the genus *Diuris*, known for its petals that poke up like "donkey ears".

<https://www.abc.net.au/news/2021-12-21/secret-crop-of-near-extinct-native-orchid-discovered/100715998>

**Professional seed hunter completes his mission to find an endangered plant — with barely a day to spare – ABC News, 29 December 2021**

Botanist Gavin Phillips has spent the past six years searching for the rare and endangered Torrington Pea. He never imagined finding a budding plant on the second-last day of his career as a professional "seed hunter".

<https://www.abc.net.au/news/2021-12-29/seed-hunter-finds-endangered-plant-on-second-last-day-on-job/100652650>

**VIDEO: Plant breeders in WA create blue variant of kangaroo paw – ABC, 10 January 2022**

The red and green kangaroo paw is a well known and much loved native flower, now plant breeders at Kings Park Botanic Garden in Western Australia have managed to create a blue version.

<https://www.abc.net.au/news/2022-01-10/plant-breeders-create-blue-variant-of-kangaroo-paw/13700326>

**We've unveiled the waratah's genetic secrets, helping preserve this Australian icon for the future – The Conversation, 13 January 2022**

When the smoke cleared after the Black Summer bushfires of 2019-20, the bush surrounding the Blue Mountains Botanic Garden Mount Tomah was charred. Among the casualties was a NSW waratah, *Telopea speciosissima*, that had recently become the first of its species to have its genome sequenced. We have published this genome in the journal *Molecular Ecology Resources*.

<https://theconversation.com/weve-unveiled-the-waratahs-genetic-secrets-helping-preserve-this-australian-icon-for-the-future-174772>

**Dinosaur food and Hiroshima bomb survivors: maidenhair trees are 'living fossils' and your new favourite plant – The Conversation, 21 January 2022**

Most of us are captivated by the thought of a "living fossil", which is any organism that appeared millions of years ago in the fossil record and survives today, relatively unchanged. The maidenhair tree, *Ginkgo biloba*, ticks all the boxes of this definition.

<https://theconversation.com/dinosaur-food-and-hiroshima-bomb-survivors-maidenhair-trees-are-living-fossils-and-your-new-favourite-plant-164630>

**Documentary series: The Green Planet**

David Attenborough's new documentary *The Green Planet* casts the spotlight on plants and their ability to inspire us. Over five episodes, *The Green Planet* will reveal the strange and wonderful world of plants like never before. For Australian audiences this show will be coming to channel Nine in February 2022.

<https://www.bbcearth.com/shows/the-green-planet>

**In a hotter Sydney, some trees will thrive while others will wither – The Sydney Morning Herald, 24 January 2022**

The big bad banksia men of May Gibbs' classic children's books are older than Australia, dating back millions of years. But the tough native species named by botanist Joseph Banks in 1770 may survive climate change only with a big dose of TLC and plenty of water.

<https://www.smh.com.au/national/nsw/in-a-hotter-sydney-some-trees-will-thrive-others-will-wither-20220119-p59pe5.html>

**The ancient, intimate relationship between trees and fungi, from fairy toadstools to technicolour mushrooms – The Conversation, 1 February 2022**

You may be familiar with the red toadstool with white spots, which are often the homes of fairies in children's stories. These toadstools are also a small part of grander magical story: they are striking examples of mycorrhizas. <https://theconversation.com/the-ancient-intimate-relationship-between-trees-and-fungi-from-fairy-toadstools-to-technicolour-mushrooms-165974>

**'Time is their secret weapon': the hidden grey army quietly advancing species discovery in Australia – The Conversation, 6 February 2022**

Each year, many new species of Australian plants, animals and fungi are discovered and described. It's detailed, time-consuming work, and much of it could not be done without the contribution of older Australians. I'm an evolutionary botanist and I use DNA sequencing to better understand relationships between plant species – a field known as phylogenetics. My job involves collecting plant specimens in the furthest corners of Australia. <https://theconversation.com/time-is-their-secret-weapon-the-hidden-grey-army-quietly-advancing-species-discovery-in-australia-175189>

**Gold Coast botanist discovers new rainforest tree species 'minutes from the M1' – ABC News, 10 February 2022**

When botanist Lui Weber visited his local physiotherapist for back treatment, he left with his head spinning after discovering a new rainforest tree species, the Wongawallan walnut (*Endiandra wongawallanensis*), in his backyard. [https://www.abc.net.au/news/2022-02-10/new-tree-species-discovery-on-gold-coast/100812328?utm\\_campaign=abc\\_news\\_web&utm\\_content=mail&utm\\_medium=content\\_shared&utm\\_source=abc\\_news\\_web](https://www.abc.net.au/news/2022-02-10/new-tree-species-discovery-on-gold-coast/100812328?utm_campaign=abc_news_web&utm_content=mail&utm_medium=content_shared&utm_source=abc_news_web)

**Giant rubber plant growing in Hobart stairwell could be 'world's biggest', fans say – ABC News, 13 February 2022**

At ground level, leaves of the giant rubber tree at Construction House in Hobart's CBD press against the glass, visible to passers by. What they can't see is the plant grows up through the entire seven-storey stairwell. Steven Holdway has been an arborist for three decades and looks after the 20-metre plant. <https://www.abc.net.au/news/2022-02-13/giant-rubber-tree-growing-in-hobart-stairwell/100803190>

**How to control a pest like Mother of Millions? – Audio on North West & Western QLD Rural Report, 17 February 2022**

A mob of cattle in south west Queensland were struck down after ingesting Mother of Millions, a restricted invasive plant. The poisonous weed often grows along shady waterways and is hard to control or eradicate. Doug Allpass from Desert Channels Queensland says it takes many years to control the pest weed once it appears. <https://www.abc.net.au/radio/westqld/programs/north-west-and-western-queensland-rural-report/mother-of-millions-kills-stock-in-western-queensland/13763602>

**Collecting seed from native plant species in Wodonga – ABC Goulbourn Murray, 17 February 2022**

A native seed is a treasured resource. Horticulturist Sue Brunskill said seeds are important for native plants to regenerate and for animals to feed on. She said collecting native seeds are an investment in the species future and a great way to understand the life cycle of a plant. <https://www.abc.net.au/radio/goulburnmurray/programs/breakfast/collecting-seed-from-native-species/13757314>

**WA on cusp of eradicating gamba grass as Queensland and Northern Territory battle to contain it – ABC News, 21 February 2022**

At first glance, gamba grass appears to fit right into Australia's natural landscape, but the tall green tussocks are an insidious threat to native animals, homes and lives. [https://www.abc.net.au/news/2022-02-21/gamba-grass-eradication-close-in-wa/100836152?utm\\_campaign=abc\\_news\\_web&utm\\_content=mail&utm\\_medium=content\\_shared&utm\\_source=abc\\_news\\_web](https://www.abc.net.au/news/2022-02-21/gamba-grass-eradication-close-in-wa/100836152?utm_campaign=abc_news_web&utm_content=mail&utm_medium=content_shared&utm_source=abc_news_web)

**Gold Coast community, council helping critically-endangered Ormeau Bottle Tree come back from extinction - ABC News, 22 February 2022**

As many native plant and animal species struggle for survival in the fast-developing region of south-east Queensland, the critically-endangered Ormeau Bottle Tree is quietly taking root and fighting back from the brink of extinction. A survey in 2009 found the species was existing with just 161 mature trees growing within a one square kilometre range of dry rainforest at Ormeau, on the northern Gold Coast. <https://www.abc.net.au/news/2022-02-22/gold-coast-ormeau-bottle-tree-back-from-extinction/100839302>

## Events and opportunities

### Managing weeds after fire – SWIFFT webinar series [Wednesdays until 16 Dec + recordings]

There's a new webinar series starting this week on managing weeds after fire. Every Wednesday for the next 4 weeks a free webinar will be held on the topic. To register or find out where to see recordings head to the SWIFFT (State Wide Integrated Flora and Fauna Teams) website

[https://www.swiff.net.au/cb\\_pages/weed\\_management\\_after\\_fire\\_-\\_webinar\\_series.php](https://www.swiff.net.au/cb_pages/weed_management_after_fire_-_webinar_series.php)

### Ecosystem Observations – TERN seminar series [recordings]

The latest seminar in this series was titled '*Standardising environmental information collection: harmonising Australia's approaches*'. To watch the recording or previous seminars head to

<https://www.tern.org.au/events/#archive>

### An-me Arri-ngun: The Food We Eat (2nd Edition)

A second edition of this landmark book is now available. The book is the culmination of decades of work describing the bush tucker of the World Heritage-listed Kakadu National Park, one of Australian's best known tourist destinations.

<https://marrawuddi.com.au/artwork/9780980831269/>

### Landcare Webinar Series

The Landcare Webinar Series brings people interested in sustainable land management and conservation activities together. It showcases the rich diversity of knowledge, passion and expertise within the landcare community. The next two webinars will be held on 2 and 10 December, register or watch recordings of previous webinars here

<https://landcareaustralia.org.au/webinars/>

### International Society for Seed Science – September 2022

The seventh edition of the Seed Ecology Conference of the International Society for Seed Science will take place in Gijón/Xixón, Asturias (Spain) from September 6 to September 9, 2022. Seed Ecology VII will accept presentations dealing with all aspects of seed ecology, with a special focus on the variation of seed functions in world ecosystems. The meeting is planned to be face-to-face, assuming the COVID situation is improving globally.

<http://www.unioviedo.es/seedecol7/>

### DAWE Podcast – Detect and Protect

In addition to the National Biosecurity Series webinars, the department has recently launched Detect and Protect – the new Australian biosecurity podcast. The discussions include the key components of Biosecurity 2030, the significant pest and disease threats facing Australia, how innovation and collaboration is helping strengthen the biosecurity system and the important role of the public in supporting biosecurity.

<https://www.awe.gov.au/biosecurity-trade/policy/australia/public-awareness/detect-protect>

### 1st International Plant Translocation Conference

After it has been postponed due to the pandemic the 1st International Plant Translocation Conference is now ready to resume in a hybrid format, with in person sessions and the possibility to follow the whole programme online.

The University of Roma Tre will host the 1st International Plant Translocation Conference from June 20-23, 2022 in Rome. The conference will be a unique occasion for conservation biologists from around the world to share their experiences, successes and misfortunes in restoring threatened plant species.

<https://host.uniroma3.it/eventi/IPTC2022/>

### Soil Ecology Research Chapter

The Ecological Society for Australia has created a Soil Ecology Research Chapter in response to the number of researchers working on plant-soil interactions. For more information on the chapter and to join their events, such as the online Journal Club, head to their website

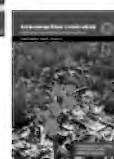
<https://www.ecolsoc.org.au/category/research-chapters/plant-soil-ecology/>

### ANPC Membership Special Offer

Join the Australian Network for Plant Conservation before **30 June 2022** to receive 2 free editions of the *Australasian Plant Conservation* bulletin!

Member benefits include:

- Quarterly editions of the APC journal
- Discounts to the ANPC's workshops, conferences and forums



### **New book on Norfolk's plants**

A new book was released in December 2021 titled 'A guide to propagating Norfolk Island's native plants and seeds'. The handbook covers an important selection of native species found on Norfolk Island. Most of the species selected are endemic and EPBC listed, as these species are unique to the island and are in the most need of propagation to increase populations. There are also some native species included because they are popular for gardens, good for revegetating property, and/or easy to grow. To access a pdf of the book head to <https://www.nespthreatenedspecies.edu.au/publications-and-tools/a-guide-to-propagating-norfolk-island-s-native-plants-and-seeds>

### **Ecologist Mental Health Resource**

The Ecological Society of Australia with the Australian Psychological Society have developed an information sheet to help ecologists and conservation scientists identify signs of distress, highlight strategies to help manage this stress and know where to seek help if needed. Find it here <https://www.ecolsoc.org.au/resources/improving-mental-health-and-wellbeing/>

### **7th Global Botanic Gardens Congress - Melbourne - Sept 2022**

The 7th Global Botanic Gardens Congress will be a joint BGCI/BGANZ Congress, hosted by Royal Botanic Gardens Victoria, held at the Melbourne Convention and Exhibition Centre in Melbourne, Australia. To be held 25 – 29 September 2022. For more information and to register your interest please visit the congress website [www.7gbgc.org/](http://www.7gbgc.org/)

### **Botanic Gardens Day 2022**

For the month of May, Botanic Gardens Australia and New Zealand Inc (BGANZ) #plantchallenge everyone to share their love of and passion for plants by posting photos / a 30-60 second video to your/our Facebook page or upload a plant image to your Instagram page or other favourite platform with a short message about what plants mean to you and how plants influence your lives, using hashtags #plantchallenge and #BotanicGardensDay. <https://www.bganzt.org.au/botanic-gardens-day-2022/>

BGANZ have organised a number of webinars and forums to celebrate Botanic Gardens Day in May. Aimed at plant lovers and professionals there is something for everyone with presentations on carnivorous plants, paleobotany, plant hunting and interpretation stories. For dates and speaker information, be sure to sign up to BGANZ's e-newsletter for more information.

[https://myemail.constantcontact.com/Get-ready-for-Botanic-Gardens-Day-2022-.html?soid=1109591060709&aid=u0t1MTOz\\_7U](https://myemail.constantcontact.com/Get-ready-for-Botanic-Gardens-Day-2022-.html?soid=1109591060709&aid=u0t1MTOz_7U)

### **Restoration questionnaire**

Emille Boulot, PhD Candidate at McGill University and a Tasmanian local is undertaking research examining the regulation of restoration across Australia. Emille is looking for restoration/rehabilitation practitioners interested in participating in an anonymous survey. This survey aims to investigate regulatory barriers and opportunities as well as regulatory processes and arrangements for ecological restoration projects. The survey can be found here, <https://survey.alchemer-ca.com/s3/50124992/The-regulation-of-ecological-restoration> and should take no more than 20 minutes to complete. Please read the consent statement before deciding whether or not to participate in the research. For more information contact Emille at [emille.boulot@mail.mcgill.ca](mailto:emille.boulot@mail.mcgill.ca)

### **ESA Conference**

This year the Ecological Society of Australia are partnering with the Society for Conservation Biology Oceania to host their annual conference on the theme 'Reconnecting'. The conference will be held from 28 November to 2 December 2022 in Wollongong, NSW. They have opened the call for symposia, with submissions closing 8 April 2022.

<https://www.esascbo2022.org.au/>

### **AABR events**

The Australian Association of Bush Regenerators have an array of exciting events scheduled for the months ahead. Head to their website to get involved.

[https://www.aabr.org.au/events/?mc\\_cid=63ca370cc9&mc\\_eid=dce52669a1](https://www.aabr.org.au/events/?mc_cid=63ca370cc9&mc_eid=dce52669a1)

### **SERA 2021 recordings**

Recordings of presentations made at the 2021 Society for Ecological Restoration Conference are now available on their website.

[https://www.seraustralasia.org/conference-2021?mc\\_cid=b9b05f8cea&mc\\_eid=12073da183](https://www.seraustralasia.org/conference-2021?mc_cid=b9b05f8cea&mc_eid=12073da183)

# Research round up

TOM LE BRETON

University of New South Wales

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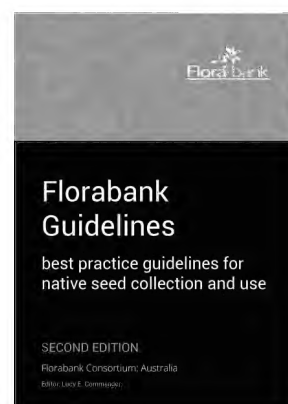
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## Florabank Guidelines best practice guidelines for native seed collection and use

Second Edition 2021 | Editor: Lucy E. Commander  
Florabank Consortium: Australia.

The second edition updates the original Guidelines, incorporating new information generated by a further 20 years of research and practice.

For more information and to order, go to [www.anpc.asn.au/florabank/](http://www.anpc.asn.au/florabank/)





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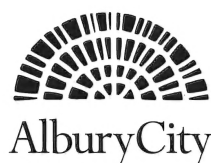
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# Plant Treasures - in conversation



## The role of the nursery and living collections in conserving native plant species: current practice and future needs

Program (Subject to change, all times AEST)

10:30am - 1:45pm AEST  
Thurs 12 May 2022

10:30	Welcome and housekeeping	<b>Dr Amelia Martyn Yenson</b> , Project Manager at the ANPC and Honorary Associate, Australian Institute of Botanical Science
10:40	Theme introduction	<b>John Arnott</b> , Manager of Horticulture at the Royal Botanic Gardens Victoria, Cranbourne Gardens and BGANZ Council representative for Victoria
10:50	VIDEO: The role of the plant nursery and living collections in <i>ex situ</i> conservation	<b>John Arnott &amp; Warren Worboys</b> , Curator of Horticulture at the Royal Botanic Gardens Victoria, Cranbourne Gardens
10:55	Overview of the Germplasm Guidelines	<b>Dr Amelia Martyn Yenson</b> , Project Manager at the ANPC and Honorary Associate, Australian Institute of Botanical Science
11:05	VIDEO: Cutting propagation in the conservation nursery	<b>Mandy Thomson</b> , Team Leader, Nursery, at the Royal Botanic Gardens Victoria, Cranbourne Gardens
11:10	QUESTIONS	
11:20	Trials, Tribulations & Triumphs in Managing a Botanic Gardens Seed Orchard	<b>Lorraine Perrins</b> , Curator, Conservation Collections and Subantarctic Flora at the Royal Tasmanian Botanical Gardens
11:30	The role of the ANBG nursery and living collections in plant conservation	<b>Dr Zoe Knapp</b> , Conservation Manager at the Australian National Botanic Gardens
11:40	VIDEO: Collection, processing and storage of fern spores	<b>Tom North</b> , Curator at the National Seed Bank, Australian National Botanic Gardens
11:50	QUESTIONS	
12:00	BREAK	
12:30	Biosecurity considerations in living collections	<b>Amanda Shade</b> , Collections and Development Manager, Botanic Gardens and Parks Authority (Kings Park)
12:45	What we can learn from conservation of crop wild relatives?	<b>Dr Sally Norton</b> , Leader of the Australian Grains
13:00	VIDEO: Using <i>ex situ</i> collections of Australian native species: Translocation and other end uses	<b>Dr Emma Dalziell</b> , Postdoctoral Research Scientist at Kings Park and Botanic Garden and the University of Western Australia <b>Dr Leonie Monks</b> , Research Scientist with the Western Australian Department of Biodiversity, Conservation and Attractions <b>Dr Andrew Crawford</b> , Research Scientist with the Western Australian Department of Biodiversity, Conservation and Attractions
13:10	<b>PANEL DISCUSSION</b> <b>Facilitated by: Michael Elgey</b> , Curator Manager, The Australian Botanic Garden Mount Annan and BGANZ Council representative for NSW	
13:45	END	

Register at:

[https://us02web.zoom.us/webinar/register/WN\\_jPghgd6TRpynB8KChazoYQ](https://us02web.zoom.us/webinar/register/WN_jPghgd6TRpynB8KChazoYQ)

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